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No Child Elects to Wait

Timely Access to Pediatric Spinal Surgery

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Key findings

- Wait times in Canada for spinal surgery that children need far exceed the recommended safe clinical time frame in several provinces.
- Beyond pain and emotional distress, wait times that lead to delayed surgeries result in increased costs due to disease progression, complications, more complex procedures, extended hospitalization, readmissions, and rehabilitation journeys.
- Delayed pediatric scoliosis surgery, based on children currently waiting beyond the recommended time frame, costs the healthcare system \$44.6 million and leads to caregiver productivity loss of \$1.4 million.

Recommendations

- Invest in Canada's peri-operative workforce with pediatric expertise.
- Increase surgical capacity to reduce the backlog.
- Prioritize postponed surgeries due to COVID-19.
- Adopt single-entry referral processes and Canada-wide standardized reporting on wait times for pediatric surgery.



Introduction

In Canada, the extended wait times for surgical procedures present a considerable obstacle to providing timely access to healthcare, not only for adults, but also for children and youth.

This research initiative, the first of a three-part series entitled *The Health and Economic Imperative for Investing in Children's Healthcare*, begins by delving into the complexities of wait times and backlogs for pediatric surgery in Canada, exploring their underlying causes and evidence-based consequences. Of particular concern is the proportion of pediatric surgeries in Canada that are not performed within the clinically recommended time frames. To illustrate the impact of children waiting for these planned and required surgeries, we focus on pediatric spinal surgery for scoliosis. We highlight the consequences on health outcomes and the economic burden caused by delays in Canadian children receiving this surgery beyond the recommended time frame.

Many children wait beyond the clinically determined benchmark for surgery in Canada

[The problem of wait-lists and backlogs in pediatric surgery has persisted for years and has been aggravated by the COVID-19 pandemic](#)

According to data from 2018, only 35 per cent of non-emergent elective (planned) surgeries in Canadian children's hospitals were completed within the recommended safe clinical time frame.^{1,2,3}

1 Skarsgard, "Prioritizing Specialized Children's Surgery."

2 Wright and others, "Waiting for Children's Surgery in Canada."

3 Arulanandam and others, "The Burden of Waiting."

The situation has significantly deteriorated in recent years, largely due to the impact of the pandemic, which has further strained healthcare systems around the world, including in Canada. Non-emergent or non-urgent surgeries have been deferred or cancelled and reduced access to surgical consultation has resulted in additional children not being wait-listed to even receive surgery. Throughout the pandemic, over 75,000 (or 23 per cent) fewer pediatric surgeries were performed in Canada compared to the pre-pandemic period.⁴

This has led to a concerning accumulation of backlogs and prolonged wait times for pediatric surgeries across the country. In Ontario, wait times have significantly increased in all 10 pediatric surgery areas compared to the pre-pandemic period, and this likely undercounts the need since there was also reduced access to consultation during this time. (See Table 1.)

While surgery volumes have been recovering, the backlog will persist until surgeries can be performed at a higher pace than before the pandemic.

Table 1
Impact of pandemic on pediatric surgery wait times in Ontario

Service area	Average monthly surgical wait-list in 2022 (# cases)	Impact of the pandemic (change from 2019 to 2022)*	Estimated average surgical wait time in 2022 (months)	Impact of the pandemic (change from 2019 to 2022)*
Pediatric cardiovascular surgery	101	22%	2.3	16%
Pediatric dental/oral/maxillofacial	3,395	-20%	6.3	30%
Pediatric general surgery	1,190	36%	4.5	66%
Pediatric gynaecologic surgery	140	45%	4.5	55%
Pediatric neurosurgery	88	32%	2.5	52%
Pediatric ophthalmic surgery	1,362	18%	5.5	45%
Pediatric orthopaedic surgery	2,059	15%	7	42%
Pediatric otolaryngic surgery	3,713	-32%	4.1	37%
Pediatric plastic and reconstruction surgery	1,694	65%	6.7	62%
Pediatric urologic surgery	3,349	78%	12.6	134%
Total	17,091	2.4%	5.9	57%

Note: Figures reflect the changes from average wait-list from January to December for 2019 to January to September for 2022.

Sources: Financial Accountability Office of Ontario; The Conference Board of Canada.

4 Canadian Institute for Health Information (CIHI), *Surgeries Impacted by COVID-19*.

Regional disparities and surgical complexity contribute to variations in timely pediatric surgery

Pediatric surgery wait times can significantly differ between provinces and territories due to variations in healthcare human resources (Table 2), population density, and the availability of specialized facilities. In 2020, there were an estimated 74 practising pediatric surgeons in Canada.⁵

Consequently, Canadian children experience longer wait times for surgery depending on where they live. As of June 2023, approximately 7,000 children in British Columbia are wait-listed for surgery. The wait times for 90 per cent of the scheduled cases completed between March and June ranged from 4.7 weeks to as long as 2.2 years, depending on the specific procedure required.⁶

The case-mix (based on diversity, complexity, and severity categories) for pediatric surgeries also contributes to variations in wait times, with urgent or emergency procedures generally having shorter wait times compared to non-urgent or elective (planned) surgeries (i.e., not as critically important to the child's immediate physiological development process and/or health outcomes). Management of elective surgeries within and/or across care centres or provincial/territorial regions are managed through wait-list prioritization approaches.⁷

Table 2

Variation in healthcare resources density across Canadian provinces

	Canada	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC
Pre-pandemic (2018)											
Paediatric physicians per 100,000 children (0–17 years)	39	53	27	49	24	44	40	38	25	39	36
Physicians per 100,000 population	227	286	188	259	232	246	211	212	209	236	234
Mid-pandemic (2021)											
Pediatric beds staffed and in operation per 100,000 children (0–17 years)	30	57	65	5	56	43	31	5	42	18	17
Registered nurses employed in direct care per 100,000 population	693	995	–	883	868	747	610	–	837	726	677

Note: Pediatric physicians include pediatric radiology, pediatric emergency medicine, pediatric general surgery, pediatrics (all 12 pediatric subspecialties) while excluding child and adolescent psychiatry and developmental pediatrics. Data for the number of pediatric physicians and all physicians are reported for the year 2018. Data for the number of pediatric beds and registered nurses are reported for the year 2021. Sources: Canadian Medical Association; Canadian Institute for Health Information, "Hospital Beds Staffed" and "Nursing in Canada"; Statistics Canada; The Conference Board of Canada.

⁵ McEvoy and others, "From Far and Wide: Geographic Distance to Pediatric Surgical Care."

⁶ British Columbia Ministry of Health, "Surgery Wait Times."

⁷ Government of British Columbia. "Understanding Wait Times."

Examining the data reported from January 2023 in Ontario (the latest data available at the time of analysis), the longest pediatric wait times were for kidney/bladder surgery, with 35 per cent and 43 per cent of patients missing the targeted time for Wait 1 (wait time to get first appointment) and Wait 2 (wait time from decision to get or schedule surgery to completing surgery), respectively. For eye surgery, 37 per cent and 27 per cent of patients missed the targeted time for Wait 1 and Wait 2, respectively.⁸ In comparison, pediatric surgeries in British Columbia with the longest wait times (Wait 2) during the same reporting period were nasal surgery, spinal/back surgery, tympanoplasty, and other urology surgeries, with the 90th percentile wait times of those completed cases exceeding one year.⁹

⁸ Ontario Health, "Wait Times."

⁹ British Columbia Ministry of Health, "Surgery Wait Times."



Delayed access to pediatric surgery packs a punch

Studies have shown that prolonged wait times for surgery can have severe repercussions on the outcomes of care provided to pediatric patients and can add to healthcare system costs. These include:

- disease progression that may result in more severe symptoms, complications, and adverse events;¹⁰
- the risk of irreversible developmental changes if certain conditions are not promptly treated;¹¹
- increased strain on healthcare resources and increased healthcare costs due to the need for additional medical interventions and more complex surgical procedures;¹²
- prolonged suffering, pain, heightened anxiety, and emotional distress experienced by both patients and families.¹³

For instance, inguinal hernias are among the three most common pediatric surgical conditions.^{14,15} Children under two years old are particularly susceptible to disease progression due to prolonged wait times. Waiting just one month for inguinal hernia surgery can result in emergency department visits. For children who visit an emergency department, approximately 25 per cent can have an incarcerated hernia (entrapped tissue or organ in hernia sac).¹⁶ Incarcerated hernias in children require immediate medical attention.

A recent Quebec study identified that children closer to 1-year in age and the specialty of their referring physicians were the two factors that significantly affected whether children received their surgery for inguinal hernia within the recommended national benchmark.¹⁷ In this study, the total burden accrued due to waiting was approximately 15 disability-adjusted life years (DALYs). That's 15 years lost of full health for children just getting their start in life.



10 Chen and others, "Impact of Wait Time"; Blair, "Wait Times Affect Kids Too"; Zamakhshary and others, "Risk of Incarceration."

11 Harrison and others, "Is There a Critical Period."

12 Ahn and others, "Empirically Derived Maximal Acceptable Wait Time for Surgery."

13 Kee and others, "Prioritising the Cardiac Surgery"; Miller, "Waiting for an Operation"; Rodrigue and Baz, "Waiting for Lung Transplantation."

14 Canadian Association of Paediatric Surgeons, "Inguinal hernias."

15 Hutson and others, "Cryptorchidism."

16 Zamakhshary and others, "Risk of Incarceration."

17 Arulanandam and others, "The Burden of Waiting."

An illustrative case: scoliosis surgery

The selection of pediatric scoliosis surgery as our case study is based on the following considerations: First, the observed substantial delays in back/spinal surgery for pediatric patients across provinces are supported by recent data. Second, adolescent idiopathic scoliosis (AIS) surgery is the most common reason for elective (planned) pediatric orthopedic surgery and is especially resource-intensive.

Scoliosis: the most common spinal deformity in school-age children

Scoliosis is an abnormal lateral (or sideways) curvature of the spine (backbone) that develops in infancy or early childhood. It commonly emerges between the ages of 10 and 15.¹⁸ Idiopathic scoliosis (unknown cause) accounts for approximately 80 per cent of all cases,¹⁹ with adolescent idiopathic scoliosis (AIS) being the most prevalent form.²⁰ Notably, girls are approximately seven times more likely than boys to experience progression of the curvature to a degree that necessitates surgical treatment.²¹

The management of scoliosis depends on its severity and the age of the child, and typically involves close observation, scoliosis-specific exercises, bracing, and surgical intervention. Although only 10 per cent of children may require surgery^{22,23,24} spinal instrumentation and fusion for adolescent idiopathic scoliosis is the most common procedure performed in pediatric orthopedics.²⁵

In Canada, 4 in 10 pediatric spinal surgeries are done after the recommended clinical time frame

The clinically recommended time frame for pediatric spinal surgery is six months, based on expert consensus.²⁶ Additionally, a study of scoliosis surgery conducted between November 1997 and August 2005 at SickKids Hospital in Toronto indicates that a three-month waiting time frame is optimal, as it reduces the risk of adverse events and allows enough time to prepare for surgery.²⁷

Across provinces, our estimated percentage of patients receiving delayed surgical treatment beyond the recommended time frame ranges from 13 per cent in Alberta to 68 per cent in Nova Scotia. (See Chart 1.) It's important to acknowledge that the availability and comparability of pan-Canadian data is limited.

18 American Association of Neurological Surgeons, "Scoliosis."

19 Ibid.

20 Thérout and others, "Prevalence of Low Back Pain"; Thomas and others, "Trends in Incidence"; American Association of Neurological Surgeons, "Scoliosis."

21 Torborg, "Mayo Clinic Q and A."

22 Roach, "Adolescent Idiopathic Scoliosis".

23 Pinto and others, "Common Sense in the Management."

24 Ahn and others, "Empirically Derived Maximal Acceptable."

25 Berry and others, "Hospital Volumes for Common Pediatric Specialty Operations."

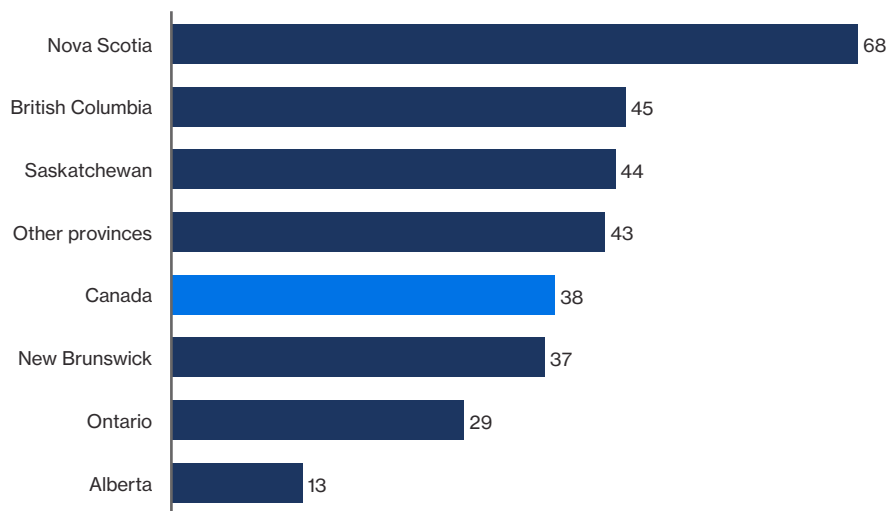
26 Wright and others, "Waiting for Children's Surgery in Canada."

27 Ahn and others, "Empirically Derived Maximal Acceptable."

Chart 1

Pediatric patients receiving back/spinal surgery beyond recommended time frame of 6 months

(% of pediatric patients)



Note: See Appendix A: Methodology for a description of our estimation approach.

Source: The Conference Board of Canada.

To estimate the number of children facing delays for spinal surgery, we assumed a prevalence rate of 2.0 per cent for AIS in children between 11 and 17 years old (based on United States data often referenced in the Canadian context). This approach accounts for 80 per cent of total scoliosis cases in children and youth; we assumed that 10 per cent of these cases will require surgical treatment. Based on these assumptions, we estimate that 2,778 children with AIS in Canada are facing delayed surgery. For detailed information on our estimation approach, please refer to Appendix A: Methodology.



Delayed scoliosis surgery for children in Canada costs the healthcare system \$44.6 million

Scoliosis can progress as a spinal deformity in growing adolescents, even with the use of bracing.²⁸ During the prolonged waiting period for surgery, the magnitude of the curve can progress to a degree where more extensive surgery becomes necessary, surpassing the initial assessment conducted when obtaining consent for surgery.²⁹ More extensive, complex surgery increases the risk of potential adverse events and surgical complications, leading to a higher likelihood of extended stay in hospital, readmission, and additional operations.³⁰

We estimate that for every 100 children experiencing delays in scoliosis surgery, the progression of curvature during the waiting period is likely to result in over 15 additional, more complex procedures than originally planned. This translates to approximately 200 extra days of hospitalization following the scheduled surgery and 3.5 more readmissions due to infection or complications. The delays in scoliosis surgery for 100 children cost an additional \$1.6 million to the healthcare system. Moreover, there is an additional cost of around \$50,000 incurred due to lost productivity

of family members who need to take time off from work to care for their children during the extended hospitalization period and readmissions. For detailed information on our estimation approach, please refer to Appendix A: Methodology.

At the population level, with an estimated 2,778 children who are waiting for surgery, the estimated cost of delaying pediatric scoliosis surgery to the healthcare system is \$44.6 million. In addition, we estimate \$1.4 million in lost productivity to the Canadian economy due to added caregiver responsibility. These costs increase as the cohort of children waiting for surgery grows. Implementing policy and systemic interventions to reduce wait times for children experiencing prolonged delays is imperative.

Our analysis (for a hypothetical cohort of 100 children) to the entire population is based on a number of assumptions and the availability of Canadian data on scoliosis surgery incidence and/or scoliosis prevalence rates. It's worth noting that while most provinces release wait time data only for completed cases, more detailed wait time data on open cases can result in a more precise estimate. Children and families deserve this, and healthcare system administrators need this data to make informed decisions.

28 Bunnell, "The Natural History"; Delorme, Labelle, and Aubin, "The Crankshaft Phenomenon"; Escalada and others, "Growth and Curb Stabilization"; Katz and Durrani, "Factors that Influence Outcome."

29 Balagué and Pellisé, "Adolescent Idiopathic Scoliosis"; Miyajima and others, "The Impact of Surgical Waitlist"; Ramo and others, "Delay to Surgery"; Tarrant, Moore, and Kiely, "Impact of Longer Surgical"; Yang and others, "Does Delaying Surgery in Immature Adolescent."

30 Ibid.

Our analysis at both the cohort and population levels does not account for the potential repercussions of delayed surgery on rehabilitation costs or expenses for families. For children with conditions like spina bifida and cerebral palsy (types of neuromuscular scoliosis), postponing surgery could lead to the loss of their ability to walk, necessitating extensive rehabilitation efforts. It typically takes nine months of rehabilitation to restore a child's mobility once it has been compromised. Consequently, the financial burden stemming from delayed surgery can compound even further for the healthcare system and Canadian families.



Discussion and calls to action

Addressing the strains on pediatric surgery capacity requires sustained funding for this type of surgery as well as targeted investments if we are to achieve meaningful reductions in wait times and enhanced patient access and outcomes over the long term. We have identified four key areas of investment that have the potential to make a positive impact.

Invest in Canada's peri-operative workforce with pediatric expertise

The shortage of nurses and anesthesiologists is a significant factor contributing to the cancellation and delay of surgeries. According to the Canadian Anesthesiologists' Society, Canada has far fewer anesthesiologists for every 100,000 people than other countries, including the United States and Australia.³¹ As highlighted in a report by the Financial Accountability Office of Ontario, "staffing shortages throughout the healthcare system and lack of capacity in home care and long-term care affects hospitals' ability to discharge patients who need care in alternate settings, which, in combination with a lack of hospital capacity and staffing, affects the ability of hospitals to admit patients from emergency departments and to reduce the surgery waitlist and wait times to pre-pandemic levels."³²

³¹ World Federation of the Societies of Anesthesiologists, "World Anaesthesiology Workforce Map."

³² Financial Accountability Office of Ontario, *Ontario Health Sector: Spending Plan Review*.

Targeted recruitment and retention strategies for registered nurses, anesthesiologists, and surgeons can help address staffing shortages, strengthen the surgical workforce, and develop professionals with expertise in pediatric procedures. Dedicated investment in nurse training, for the near term, and resource planning for the long-term sustainability of Canada's pediatric workforce is critically important.

It's a tall order that hospitals and healthcare systems across the country are currently making efforts to address. The Canadian Academy of Health Sciences (CAHS) has proposed priority pathways for the early implementation of leading policies and practices to respond to, plan, and prioritize health human resources.³³

Investing in employee well-being programs within hospitals can further support this goal towards a healthcare workforce with experience and expertise in pediatrics.

Increase surgical capacity to reduce the backlog

Expanding scheduled surgical capacity through longer weekday and weekend slates, along with extra operating rooms, can help address the backlog of surgeries. This approach aims to increase the number of procedures performed, effectively reducing wait times for patients.

Hospitals impacted by the COVID-19 pandemic can effectively utilize targeted government funding to alleviate the surgical backlog through innovative models of service delivery. One successful example involves novel pilot weekend surgical programs, such as ORRACLE-Xtra (Operating Room Ramp-Up After COVID Lockdown Ends—Extra Lists), that have been implemented at SickKids

Hospital in Ontario. By employing the Lean-Six Sigma methodology, ORRACLE-Xtra demonstrated promising outcomes, achieving a 5.0 per cent reduction in the surgical backlog and addressing the need of patients who fell outside the treatment window targets.³⁴ The program optimized efficiency by scheduling weekend elective surgeries using six dedicated operating rooms and harnessing machine learning to predict anesthesia and surgical times and nursing staff availability.

Saskatchewan's progress in addressing lengthy surgical wait times serves as a powerful example of an effective wait-list management strategy. The Saskatchewan Surgical Initiative, launched in 2010, encompassed a range of measures, including a fair operating room allocation system, a centralized provincial surgery registry, the integration of priority scoring tools, and the creation of the Saskatchewan Surgical Care network.³⁵

The initiative adopted a coordinated approach that incorporated Lean principles, hospital service consolidation, private third-party surgical care delivery services, and policy direction set by the provincial government. As a result, the province significantly reduced surgical wait times, transitioning from one of Canada's longest to one of the country's shortest by 2015.³⁶

Solutions can also go beyond the hospital and into the community. Integrated surgical programs for children and youth can establish safe and supportive care in community hospitals when recovery and rehabilitation needs can be safely met following procedures in specialty children's hospitals. Such programs can create additional capacity for specialized surgical procedures, while offering children and families a safe and supportive environment for post-operative care and follow-up closer to home.

34 Matava and others, "A Canadian Weekend Elective Pediatric Surgery Program."

35 Johnston, "Saskatchewan's Successful Strategy."

36 Johnston, "Saskatchewan's Successful Strategy"; MacKinnon, *Learning from the Saskatchewan Surgical Initiative*.

33 Canadian Academy of Health Sciences, *Canada's Health Workforce*.

Prioritize postponed surgeries due to COVID-19

Giving priority to surgeries postponed due to the COVID-19 pandemic and to procedures with shorter wait-time targets can mitigate potential harm to patients, particularly for cases at risk of progressing rapidly.

Patient prioritization methods can shorten wait times using a robust framework that involves both clinical, ethical, socio-economic factors and patient-reported feedback or outcome measures.³⁷ Using existing standardized patient prioritization tools or patient reported outcomes measures, or developing new ones tailored to each specialty and patient cohort, can effectively support wait-list management within and across specific disciplines.³⁸

Adopt single-entry referral processes and Canada-wide standardized reporting on wait times for pediatric surgery

Getting to the heart of access to care and surgical services means reducing variation in pathways to getting there. Single-entry referral processes have demonstrated their effectiveness in reducing wait times for outpatient surgical referrals.³⁹ Access to elective (planned) surgeries through a single-entry process, in both Canadian and international research, has demonstrated reduced waiting times, more patients meeting clinically recommended targets, and reduced wait-lists overall.⁴⁰ These are the outcomes of interest to children waiting for surgery, to their families, and to the professional teams engaged in their care.

Standardized reporting of wait times is another important aspect for effective healthcare and healthcare system management. And requirements for pediatric surgery have been established and agreed upon. The Canadian Pediatric Surgical Wait Times project established access targets for over 800 diagnoses across 11 surgical disciplines, providing expert consensus-based benchmarks for surgery wait times. Enabling a learning healthcare system, fostering accountability, and facilitating continuous improvement and equity in access requires timely data and transparency.

Yet, the reality is that only five provinces in Canada regularly release some form of data on wait times for pediatric surgery, and there are significant variations and inconsistency in the number of procedures and time frame included in their reporting. This lack of uniformity makes it challenging to compare reported wait times across jurisdictions, highlighting the need for national indicators to ensure equity and accountability.

No child elects to wait for a surgery they need. What is needed are standardization of reporting on the implementation of solutions and compliance in meeting benchmark targets across jurisdictions, and expansion of publicly available reporting tools tailored for the pediatric population. Such measures will make it easier to better identify and monitor ongoing trends and areas requiring improvement and to acknowledge excellence.

37 Rathnayake and others, "Patient Prioritisation Methods."

38 Déry and others, "Patient Prioritization Tools."

39 Milakovic and others, "Effects of a Single-Entry Intake System."

40 Damani and others, "What is the Influence of Single-Entry Models."

Appendix A

Methodology

Scoliosis surgery

The objective of this case study is to examine the impact of delayed scoliosis surgery on health resource utilization and overall costs, encompassing both surgical expenses and associated adverse events. Our primary focus is on pediatric patients who require scoliosis surgery, but experience wait times exceeding the recommended six-month period.

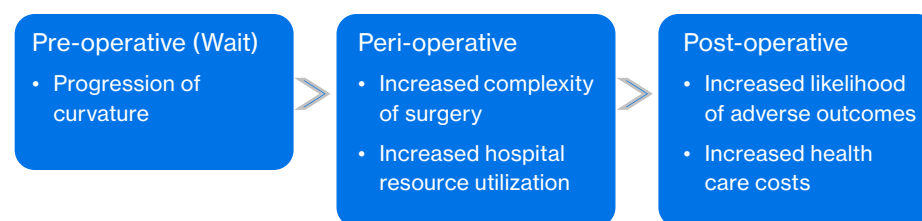
To estimate the proportion of such patients facing prolonged wait-listing, we made several assumptions and inferences due to limited data availability. For Alberta, we used the wait time distribution reported for all spinal/back surgeries, including adults. In Ontario, we based our estimate on the reported percentage of patients treated within the target for either Wait 1 or Wait 2, whichever was lower. Linear interpolation approaches, using reported wait times for median and 90th percentile patients, further calibrated with the Alberta distribution, were applied for British Columbia, Saskatchewan, New Brunswick, and Nova Scotia. For all remaining provinces, we assumed the arithmetic average across the six sample provinces. The estimate for Canada was then calculated as the population-weighted average across all 10 provinces.

While most provinces release wait time data only for completed cases, we acknowledge that more detailed wait time data on open cases would be beneficial. Data such as the number of patients waiting, wait time distribution, and specifics about scoliosis type and severity of deformity, such as Cobb angle and Risser score, could enhance our analysis. Our study would be further strengthened by obtaining data from provinces where such information is not available currently. Having more comprehensive and detailed data would lead to a more thorough and accurate assessment of the impact of prolonged wait times on scoliosis patients and inform potential policy interventions to improve access to timely care.

To assess the health and financial impact of prolonged waiting, we conducted an extensive literature review across the care continuum, focusing on three phases: pre-operative, peri-operative, and post-operative. (See Exhibit A1.) The evidence revealed that excessive wait times lead to increased curvature progression, necessitating more complex surgeries and higher medical resource utilization during the peri-operative phase. Moreover, the post-operative phase has a higher likelihood of adverse events, resulting in elevated healthcare costs. While we also considered potential peri-operative outcomes of prolonged wait times, such as pain management, timing for a return to school/college or physical activity, self-esteem, and rehabilitation needs, we could not include these in our model as sufficient empirical evidence and/or data on the characteristics of those patients wait-listed is scarce.

Exhibit 1

Modelling framework for analyzing the health and economic impact of delayed scoliosis surgery
(% of pediatric patients)



Source: The Conference Board of Canada.

We utilized parameters from published sources to estimate the expected risk for each outcome in the population receiving surgery within the recommended time frame and the risk of the outcome in the population receiving surgery outside of that time frame. We were then able to calculate the excess risk of each outcome attributable to delayed surgery by subtracting the expected risk among those within the window from the risk among the population receiving surgery outside of the window.

To estimate the number of individuals experiencing each adverse outcome due to delayed surgery, we multiplied the excess risk of each outcome by the relative population with idiopathic scoliosis or neuromuscular scoliosis receiving surgery outside of the clinically safe window. In cases where data on risks for individuals receiving surgery outside of the window were not available, we applied an odds ratio for adverse events to the risks for individuals receiving surgery within the window to derive the excessive risk associated with delayed surgery.

We also considered caregiving costs as the forgone earnings of a parent who would be absent from work to take care of their children during their extended hospitalization as a result of adverse events caused by the delayed surgery.

Finally, our analysis does not account for the potential repercussions of delayed surgery on rehabilitation expenses. For children with conditions like spina bifida and cerebral palsy or those with GMFCS Levels 4-5, postponing surgery could result in the loss of their ability to walk, which would then lead to extensive and prolonged rehabilitation efforts. Typically, restoring a child's mobility after it has been compromised takes 9 to 12 months of rehabilitation, as opposed to a shorter recovery period of 3 to 6 months if surgery is not delayed. Consequently, the financial burden stemming from delayed surgery can compound even further for the healthcare system.

Appendix B

Model input

Table 3
Scoliosis model

Parameter	Value/range	Source(s)
Impact of delay to surgery greater than 6 months		
Adjusted odds ratio for the occurrence of adverse event by wait time per additional 90 days	1.81 [1.34, 2.44]	Ahn and others
additional procedure due to progression of curvature	0.131 (idiopathic) 0.28 (neuromuscular)	Hollenbeck and others; Ahn and others
medical surgical time	48 minutes	Ahn and others
median length of stay in hospital after surgery	2 days [1,5]	Ibid
changed plans (e.g., anterior/posterior procedures)	2.0% [1.4, 2.6]	Ibid
treatment value/cost	25%	Lynch and others
Post-operative readmission	0.029 (30-day readmission); 0.014 (90-day readmission)	Lee and others
Reoperation rate among readmission cases	0.064 (30-day); 0.237 (90-day)	Ibid.
Cost: index admission	60,680	Ibid.
Cost: 30-day readmission without reoperation	23,567	Ibid.
Cost: 90-day readmission w/o reop	16,916	Ibid.
Cost: 30-day readmission requiring reop	65,986	Ibid.
Cost: 90-day readmission requiring reop	39,713	Ibid.
Cost: hospitalization per patient/day	7,893 [6,493,8,825]	Bozzio and others; CIHI
Cost: average hourly rate, caregivers	31.96	Statistics Canada

Source: The Conference Board of Canada.

Appendix C

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