Alberta's Strategic Clinical Networks

Appendices

An interim analysis of SCN return on investment, value and impact 2012–2019

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Strategic Clinical Networks™

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Appendices

Appendix A Detailed methods, examples and uncertainty analysis

Appendix B Unit costs and data sources

Appendix C Core infrastructure and operating costs by SCN and year

Appendix D Funding support for SCNs from non-AHS sources, 2012–2019

Appendix E Project information and evaluations

Appendix A Detailed methods, examples and uncertainty analysis

SCN return on investment (2012–2019)

For the ROI analysis, we evaluated monetary benefits, including direct health system savings ('dark green dollars'; e.g., cost avoidance, disinvestment or discontinuation of ineffective health services and technologies) as well as savings resulting from changes in health service utilization (HSU) and productivity (e.g., reductions in length of stay, hospital readmissions, cases prevented). We compared monetary benefits to the costs of SCNs to calculate the net monetary benefit and return on investment ratio using the following formulas:

NB = B – C and ROI = B/C

where NB is net monetary benefits, ROI is the return on investment ratio, B is monetary benefits, and C is costs of SCNs.

Fifteen projects were included in the Base Case. Monetary benefits were estimated using one of three methods, depending on the type of project and data availability.

Estimating savings resulting from changes in HSU

Methods 1 and 2 apply to projects where the intervention impacted HSU. For these projects, we estimated monetary benefits from the start date of the intervention to March 31, 2019 using this formula:

Total costs or savings = costs or savings per patient * number of patients impacted

Costs or savings per patient in the evaluation period were assumed to continue to March 31, 2019. All projects were implemented prior to April 1, 2018, which ensured a minimum one-year evaluation period.

Method 1 – For projects with a formal evaluation paper completed (e.g., ERAS, NSQIP, START), we divided reported total costs or savings by the number of patients to estimate the cost per patient. We then used this value and the number of patients impacted from the intervention start date to March 31, 2019 to calculate total costs or savings to AHS over the evaluation period according to the formula above.

Method 2 – For projects that did not have a formal evaluation paper estimating costs or savings per patient, but impacts on HSU were measured, we used the changes in HSU multiplied by a respective unit cost to calculate the costs or savings. The unit cost represented the direct health system costs (e.g., per surgical bed day, readmission). Unit costs are listed in Appendix B. For projects that calculated the impacts of the intervention in terms of cases or events prevented or avoided, we multiplied the number of avoided cases/events with the unit cost of that case/event to calculate the monetary benefits.

For both methods 1 and 2, we only assessed the short-term impact of each intervention on a patient's HSU. Specifically, for each patient, we estimated the impact over one year or less.

Estimating savings resulting from disinvestment

Method 3 applies to projects relating to disinvestments of ineffective services or technologies.

Method 3 – For projects involving disinvestment, we estimated total cost savings by (i) multiplying the number of people that would have been expected to use the ineffective intervention by the cost of the ineffective service/technology per patient, or (ii) multiplying the number of years between disinvestment effective date and March 31, 2019 with the cost of the ineffective service/technology per year. The cost of the ineffective service/technology per year was estimated as the difference in costs of that service/technology for one year before and year after the disinvestment. We also included the measured impact of the health system resource use (and costs) that occurred because of using the ineffective service/technology. In situations where the ineffective service/technology was replaced by another (e.g., Epoprostanol instead of iNO for adult intensive care units), the cost of the replacement was also included in the calculation.

Number of patients impacted

The number of patients impacted by the intervention was determined from the start date of intervention(s) to March 31, 2019. This information was retrieved from AHS administrative databases using Tableau where possible. For projects where this data was not yet calculated, we estimated the number of patients impacted from the start date of intervention(s) to March 31, 2019 proportionately, using this formula:

$$N_2 = N_1/T_1 * T_2$$

where N_2 is the number of patients impacted by the intervention from the start date of the intervention to March 31, 2019; N_1 is the number of patients impacted by the intervention within the evaluation time period; T_1 is the length of the evaluation time period (in years); and T_2 is the length of time from the start date of the intervention to March 31, 2019 (in years). We assumed that the number of patients impacted by the intervention per year remained the same after the evaluation period.

Trend analysis

For Method 2, we used historical trend analysis to estimate the outcomes (e.g., complications; length of stay) that would have been *expected* if the intervention had not been implemented). We then compared the *expected* with the *actual observed* outcomes to identify the change attributable to the intervention (e.g., clinical pathway implementation). Example 1 shows how the trend analysis was done and used to calculate total savings for the Hip and Knee Pathway.

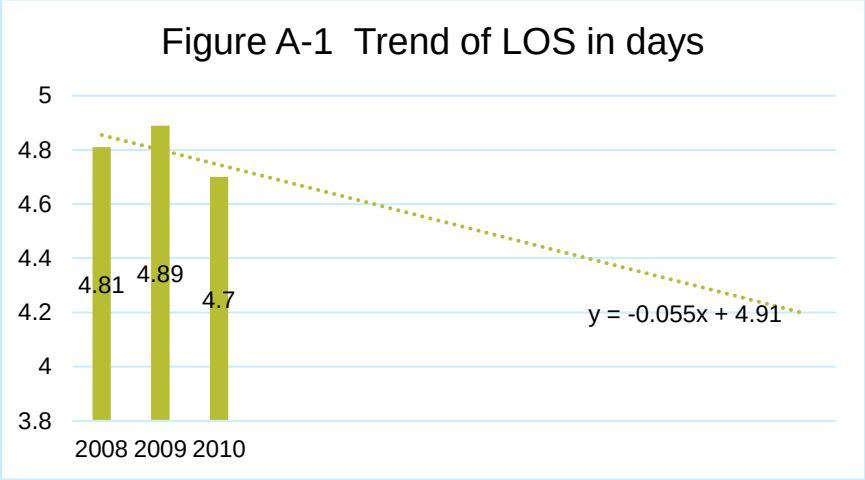
Example 1 Trend analysis for Hip and Knee Pathway

Costs or savings of the Hip and Knee pathway were based on impacts of the intervention on hospital length of stay (LOS) per surgery and on the percentage of surgeries with blood transfusion. The costs or savings for the LOS impact were estimated by multiplying the change in LOS in days due to intervention with the cost per day. The costs or savings for the blood transfusion impact were estimated by multiplying the change in the number of blood transfusions due to intervention with the cost per transfusion.

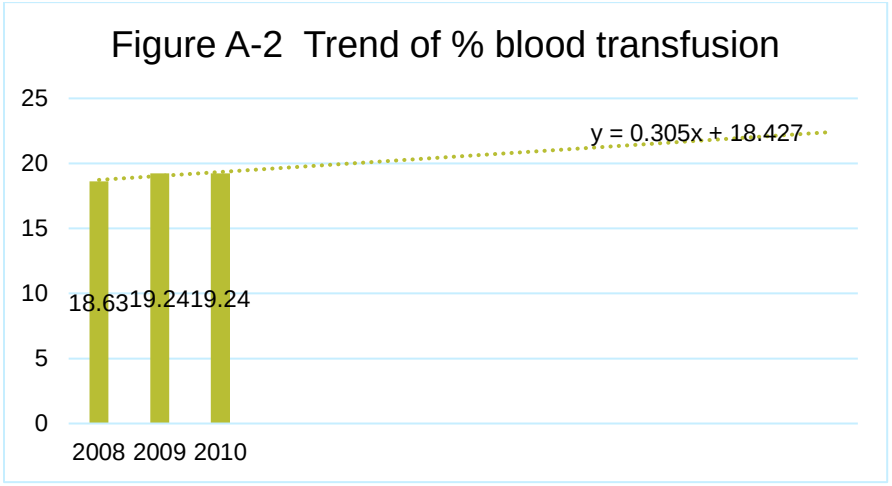
The changes in LOS or blood transfusions due to intervention were the differences between the expected and the observed numbers. The expected was the LOS per surgery or the percentage of blood

transfusions we would have expected if the intervention had not been implemented. We used the trend in data three years prior to the intervention start date with a linear regression to estimate the expected LOS and the expected percentage of blood transfusions for every fiscal year after the intervention until March 31, 2019. The observed LOS, percentage of blood transfusions, and number of surgeries in each fiscal year were retrieved from AHS administrative databases.

Based on data from 2008 to 2010, we forecasted that LOS per hip or knee surgery would follow the equation: y = -0.055x + 4.91 (Figure A-1), where y is LOS and x is the ordinal number of years in the evaluation period (2008 = 1, 2009 = 2 …., 2019 = 12). Using this equation, we estimated the expected LOS for each year from 2011 to 2019 (see Table A-1, column 2).



Based on data from 2008 to 2010, we also forecasted that percentage of blood transfusions among hip and knee surgeries would follow the equation: y = 0.305x + 18.427 (Figure A-2), where y is the percentage of surgeries involving blood transfusion and x is the ordinal number of years in the evaluation period (2008 = 1, 2009 = 2 …., 2019 = 12). Using this equation, we estimated the expected percentage of surgeries requiring blood transfusion for each year from 2011 to 2019 (see Table A-1 column 2).



Actual LOS and percentage of surgeries requiring blood transfusion after the intervention (from 2011 to 2019) were retrieved from AHS data (DIMR/Tableau) (see Table A-1, column 3).

The difference (change) between the expected and the actual values was considered the impact of the intervention (see Table A-1, column 4). We multiplied the change (column 4) with the number of patients (column 5) to calculate the total change in HSU (column 6). The total savings (column 8) were equal to the total changes in HSU (column 6) multiplied by the unit cost (column 7). We estimated the total savings for each fiscal year (column 8) and then summed these to calculate the total cumulative savings for all years of the evaluation period ($72.25M).

Table A-1 Calculated savings for the Hip and Knee Pathway

Column 1	2	3	4	5	6	7	8
HSU / year	Expected	Actual	Change	# patients	Total changes in HSU (#)	Unit cost[(a)] ($)	Total savings ($M)
LOS							
2010/2011	4.69	4.34	0.35	7,520	2,632.00	$977.02	$2.57
2011/2012	4.64	4.14	0.50	8,716	4,314.42	$977.02	$4.22
2012/2013	4.58	4.05	0.53	9,131	4,839.43	$977.02	$4.73
2013/2014	4.53	3.99	0.54	9,192	4,917.72	$977.02	$4.80
2014/2015	4.47	3.85	0.62	9,429	5,845.98	$977.02	$5.71
2015/2016	4.42	3.78	0.64	9,774	6,206.49	$977.02	$6.06
2016/2017	4.36	3.41	0.95	10,036	9,534.20	$977.02	$9.32
2017/2018	4.31	3.16	1.15	10,037	11,492.37	$977.02	$11.23
2018/2019	4.25	2.89	1.36	10,365	14,096.40	$977.02	$13.77
Sub-Total[(b)]				*84,200*			*$62.41*
% Blood Transfusions							
2010/2011	19.65%	18.19%	1.46%	7,520	109.57	$908.41	$0.10
2011/2012	19.95%	16.13%	3.82%	8,716	333.13	$908.41	$0.30
2012/2013	20.26%	13.88%	6.38%	9,131	582.28	$908.41	$0.53
2013/2014	20.56%	9.86%	10.70%	9,192	983.73	$908.41	$0.89
2014/2015	20.87%	6.21%	14.66%	9,429	1,382.01	$908.41	$1.26
2015/2016	21.17%	4.49%	16.68%	9,774	1,630.50	$908.41	$1.48
2016/2017	21.48%	3.26%	18.22%	10,036	1,828.26	$908.41	$1.66
2017/2018	21.78%	2.78%	19.00%	10,037	1,907.23	$908.41	$1.73
2018/2019	22.09%	2.03%	20.06%	10,365	2,078.91	$908.41	$1.89
Sub-Total[(b)]				*84,200*			*$9.84*
Total[(b)]							**$72.25**

Notes:

(a) For unit costs and data sources, see Appendix B.
(b) Average savings per patient = $72,253,947/84,200 = $858.12

Uncertainty analyses

To account for uncertainty in calculating the net benefits and ROI, we included a scenario analysis, a one-way sensitivity analysis and a probabilistic sensitivity analysis.

Scenario analysis

To incorporate conservatism to the ROI analysis, we evaluated two additional assessment scenarios:

Scenario 1: All SCNs and all projects

In this scenario, we included the cumulative start-up and operating total costs for all 16 SCNs, pan-SCN support and all SCN projects (including those in progress and not included in the Base Case) for each year. We compared these costs to benefits (from 15 selected projects) to calculate the NB and ROI ratio.

Scenario 2: All SCNs, all projects and AHS support services and resources

For this scenario, we included all costs from Scenario 1 as well as AHS support services and resources that cannot be attributed to any one project or SCN. In doing so, Scenario 2 accounts for costs that exist outside the SCN budget but involve AHS resources that support SCN work. These include AHS Finance, Information Technology, DIMR, CMO, HTAI, and Priority and Performance.

Results of the scenario analysis are presented in Table 2 (main report) and Appendix C.

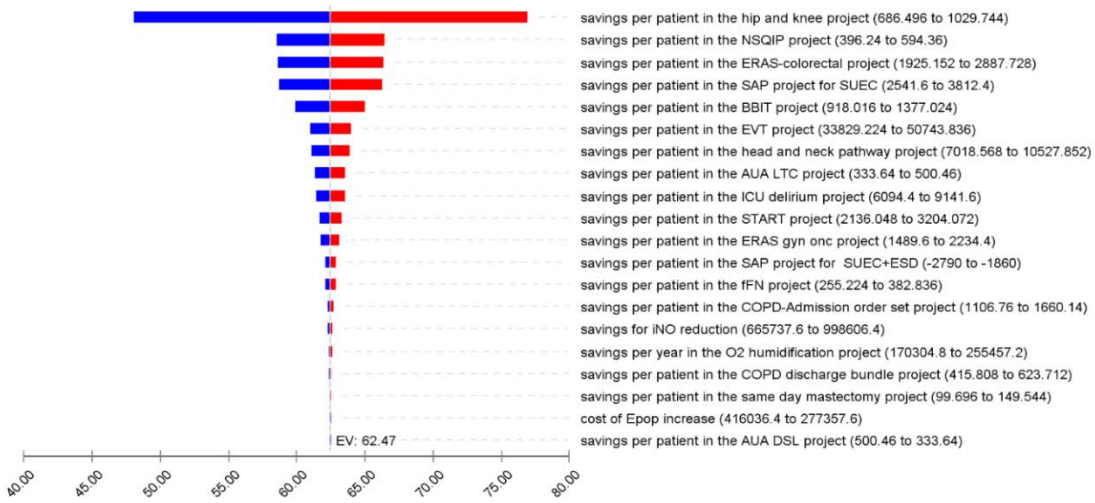
Deterministic sensitivity analysis

For the deterministic sensitivity analysis, we performed a one-way sensitivity analysis (one variable varied at a time) assuming each variable varied by ±20% of the Base Case value. We reported the widest range in Table A-2 and the variation by variable in a tornado diagram (Figure A-3) where the most sensitive variable (widest variation of net benefits) is at the top and the least sensitive variable is at the bottom.

Table A-2 Results of the deterministic sensitivity analysis

Outcome	Low	Base	High
Net benefit (NB)	$48.02 Million	$62.47 Million	$78.92 Million
Return on investment ratio (ROI)	1.4	1.54	1.7

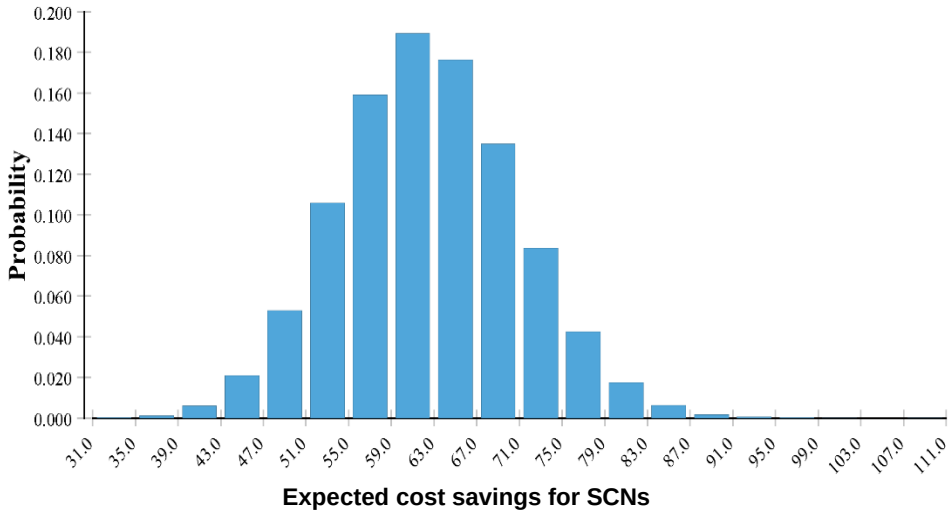
Figure A-3 Tornado Diagram - Incremental Benefits vs. Costs



Probabilistic sensitivity analysis

The probabilistic sensitivity analysis (PSA) allows the uncertainty in all variables to vary concurrently. For this analysis, we used a gamma distribution for variations of costs and a normal distribution for variations in the number of patients impacted by the intervention (where actual data were not available). We used the Base Case value as the mean and the ±20% variation as the 95% confidence interval to calculate the standard deviation. We ran 100,000 samples/trials and reported a probability of SCNs to be cost saving. Results of the PSA are shown in Figure A-4.

Figure A-4 PSA results



Appendix B Unit costs and data sources

Table B-1 lists the unit costs and data sources used in the interim return on investment analysis. All information is based on the most current available data. Detailed information and references are available upon request.

Unit costs were used to estimate project costs or savings using Methods 2 and 3. This did not apply to project evaluations that used Method 1. These methods are described in Appendix A.

Table B-1 Unit costs used in estimating costs, savings and return on investment

Unit	Cost	Data source[(a)]
Surgical bed day	$977	AHS DIMR (2019)
Intensive care unit (ICU) bed day	$3,475	Tran et al. (2019a)
Chronic obstructive pulmonary disease (COPD) bed day	$1,203	Tran et al. (2019b)
Diabetic bed day	$1,147	AHS Finance, BAS (2019)
Blood transfusion	$908	AHS Finance, BAS (2016)
COPD case	$12,994	Tran et al. (2019b)
Delirium case	$7,618	Cole and Osiowy (2019)
Endovascular therapy (EVT) case (savings per year)	$42,287	Cardiovascular Health and Stroke SCN (2019)
Stroke case	$40,481	Zheng et al. (2019)
Transient ischaemic attack (TIA) case	$5,858	Alberta Health (2017)
Fetal fibronectin (fFN) test	$136	Chuck et al. (2016)
Inhaled nitric oxide (iNO) hour	$96.67 (to March 2017) $33.49 (after March 2017)	Estimated from AHS data provided by CPSM and DIUS
Epoprostanol (Flolan®) hour	$6.17	Estimated from AHS data provided by CPSM and DIUS

Notes:

(a) References provided in Appendix D.
(b) DIMR = AHS Data Integration, Measurement and Reporting; BAS = Business Advisory Services; CPSM = AHS Contracting, Procurement and Supply Management; DIUS = AHS Drug Information, Utilization and Stewardship.

Appendix C Core infrastructure and operating costs by SCN and year

Table C-1 lists the total SCN project, administrative and operating costs by year for **all** SCNs (used in Scenario 1; Appendix A) and the total adjusted costs with AHS support services and resources included (used in Scenario 2; Appendix A).

Table C-1 Costs of all SCNs and all projects by year

SCN	2012/13[a]	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	Cumulative Total
AMH	$ 0.79	$ 1.34	$ 1.20	$ 1.15	$ 1.17	$ 1.26	$ 1.35	$ 8.24
Bone & Joint	$ 0.89	$ 2.30	$ 3.63	$ 4.53	$ 3.87	$ 4.14	$ 4.76	$ 24.13
Cancer	$ 0.95	$ 0.97	$ 1.04	$ 1.46	$ 1.27	$ 1.80	$ 1.15	$ 8.65
Cardiovascular Health & Stroke	$ 0.98	$ 2.64	$ 6.04	$ 5.59	$ 1.45	$ 1.60	$ 1.75	$ 20.06
Critical Care	$ 0.52	$ 0.85	$ 1.08	$ 1.00	$ 0.94	$ 1.28	$ 1.28	$ 6.96
DON	$ 0.71	$ 0.94	$ 1.17	$ 1.24	$ 1.36	$ 1.78	$ 1.80	$ 9.00
Digestive Health	$ -	$ -	$ -	$ -	$ 0.56	$ 0.97	$ 1.20	$ 2.72
Emergency	$ 0.02	$ 0.72	$ 0.62	$ 1.34	$ 1.12	$ 1.12	$ 1.33	$ 6.27
Kidney Health	$ -	$ -	$ 0.08	$ 0.56	$ 1.10	$ 1.72	$ 1.59	$ 5.04
MNCY	$ -	$ -	$ 0.76	$ 0.85	$ 0.80	$ 0.94	$ 1.09	$ 4.44
NRV	$ -	$ -	$ -	$ -	$ -	$ 0.23	$ 0.23	$ 0.46
PHCIN	$ -	$ -	$ -	$ 0.28	$ 0.24	$ 0.71	$ 0.68	$ 1.91
PPIH	$ -	$ -	$ -	$ 0.28	$ 0.24	$ 0.23	$ 0.23	$ 0.98
Respiratory Health	$ 0.55	$ 0.63	$ 0.84	$ 0.97	$ 0.82	$ 1.08	$ 1.12	$ 6.01
Seniors Health	$ 0.73	$ 1.40	$ 1.56	$ 1.26	$ 1.32	$ 1.65	$ 1.55	$ 9.49
Surgery	$ 0.40	$ 1.63	$ 3.88	$ 5.06	$ 5.86	$ 6.62	$ 8.68	$ 32.13
Pan-SCN	*$ 3.53*	*$ 1.40*	*$ 1.52*	*$ 1.24*	*$ 2.35*	*$ 4.01*	*$ 3.55*	*$ 17.60*
Total[b]	**$ 10.07**	**$ 14.83**	**$ 23.42**	**$ 26.81**	**$ 24.47**	**$ 31.14**	**$ 33.34**	**$ 164.07**
Support services/ resources[c]	*$ -*	*$ 0.94*	*$ 0.94*	*$ 0.97*	*$ 0.97*	*$ 0.97*	*$ 0.97*	*$ 5.77*
Total Adjusted	**$ 10.07**	**$ 15.77**	**$ 24.36**	**$ 27.78**	**$ 25.44**	**$ 32.11**	**$ 34.31**	**$ 169.84**

Notes:

(a) Costs accrued in 2011/12 (approximately $0.6M for startup, administration and research) were added to 2012/13.

(b) Total includes all core infrastructure, operating, administrative and projects costs for all SCNs, as well as pan-SCN support. Specifically:

- **Core infrastructure and operating costs** include SCN leadership, Scientific Office and operational staff.
- **Administrative costs** include office administration, communications and other coordination.
- **Project costs** include all projects SCNs have undertaken, from planning, pilot execution, evaluation and implementation. It also includes clinical guidance and other work SCNs support to embed evidence into care. Additional resources required to implement or accommodate changes in practice were funded through SCN budgets and are included in the total project and SCN costs.
- **Pan-SCN costs** include centralized leadership and support extended across all SCNs.

(c) Total adjusted includes support services and resources embedded within AHS Finance, IT, DIMR, CMO, HTAI, and Priority & Performance. These resources and services are not part of SCN budgets but are allocated to support SCNs.

Appendix D Funding support for SCNs from non-AHS sources, 2012–2019

Since 2012, the SCNs have either led or been a major collaborator in clinical research that has brought $65.84M in grants to Alberta from funding sources outside the province (see Table 4 in the main report). In addition, the networks, together with operational and academic partners, have secured an additional $58.27M in funding from external (non-AHS) sources within Alberta. These sources include charitable foundations, industry and non-AHS contributions to health innovation grants from Alberta Innovates and Alberta Health (e.g., PRIHS and HIIS).

As Table D-1 shows, SCNs have received $124.11M in cumulative funding support since 2012 from granting agencies external to AHS. This includes sources within Alberta and outside the province, and includes funding support for health system research and innovation in which SCNs have contributed in a leading, collaborating or supporting role (Table D-2). In all cases, the funds have been used to support Alberta health system priorities. Since 2012, these funds, together with grants received from sources outside the province, have supported 56 health research and improvement initiatives in Alberta.

Table D-1 Funding support from sources external to AHS, 2012 to 2019 ($ Million)

SCN	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	Cumulative Total
AMH	$ 2.19	$ -	$ -	$ -	$ 0.67	$ 4.82	$ 1.28	**$ 8.95**
Bone & Joint Health	$ 0.05	$ 1.42	$ 3.93	$ -	$ 0.10	$ 3.06	$ 0.02	**$ 8.64**
Cancer	$ -	$ 0.39	$ 4.5	$ 0.92	$ 1.24	$ 1.75	$ 0.61	**$ 9.38**
Cardiovascular Health & Stroke	$ -	$ 5.66	$ 0.67	$ 7.35	$ 1.70	$ 2.86	$ 1.9	**$ 20.15**
Critical Care		$ 1.34	$ 1	$ 3.94	$ 1.3	$ 0.75	$ 0.10	**$ 8.42**
DON	$ -	$ 0.37	$ 0.04	$ 1.43	$ 0.06	$ 0.02	$ 0.02	**$ 1.93**
Digestive Health				$ 0.30	$ 0.15	$ 0.08	$ 1.78	**$ 2.30**
Emergency		$ 1.1	$ -	$ 0.05	$ 0.03	$ 1.75	$ 0.27	**$ 3.20**
Kidney Health			$ 0.38	$ 3.87	$ 0.44	$ 1.04	$ 5.24	**$ 10.97**
MNCY			$ 5.98	$ 1.70	$ 1.10	$ 1.57	$ 0.42	**$ 10.78**
NRV							$ -	**$ -**
PHCIN					$ 1.00	$ 0.48	$ 7.23	**$ 8.72**
PPIH				$ -	$ -	$ 7.5	$ 1.22	**$ 8.72**
Respiratory Health		$ 0.78	$ -	$ -	$ 0.27	$ 0.03	$ -	**$ 1.07**
Seniors Health	$ 1.62	$ 5.57	$ 6.05	$ 1.81	$ -	$ 2.51	$ 2.34	**$ 19.92**
Surgery		$ -	$ -	$ -	$ 0.08	$ 0.77	$ 0.06	**$ 0.91**
Total	**$ 3.86**	**$ 16.62**	**$ 22.55**	**$ 21.37**	**$ 8.14**	**$ 29.1**	**$ 22.5**	**$ 124.11**

Note: Blank (grey) cells indicate years prior to the SCN launch.

Table D-2 Number of SCN grant-funded health research projects, 2012 to 2019

SCN[a]	Number of health research grants received	Number of research grants by SCN role			Number of projects supported by these grants[b, c, d]
		Lead	Collaborate	Support	
AMH	10	10	-	-	**3**
Bone & Joint Health	16	6	7	3	**3**
Cancer	27	7	2	18	**7**
Cardiovascular Health & Stroke	33	7	21	5	**4**
Critical Care	27	13	12	2	**6**
DON	8	6	2	-	**8**
Digestive Health	8	5	3	-	**4**
Emergency	12	5	7	-	**4**
Kidney Health	15	3	4	8	**3**
MNCY	12	5	7	-	**3**
NRV	0	-	-	-	**-**
PHCIN	10	1	9	-	**3**
PPIH	9	9	-	-	**1**
Respiratory Health	5	3	2	-	**3**
Seniors Health	27	9	10	8	**3**
Surgery	5	1	3	1	**1**
Total[e, f, g]	**224**	**90**	**89**	**45**	**56**

Notes:

(a) Projects and grants involving more than one SCN were attributed to the leading SCN.
(b) Research projects vary in size and scope. Projects listed in the far-right column are initiatives in which the SCN played a lead role.
(c) In some cases, a combination of grants funded one initiative. Since 2012, the SCNs have led 90 grant applications in Alberta and successful grant applications have funded 56 health research initiatives.
(d) The total number of grant-funded projects excludes health research in which SCN contributions are not categorized as SCN led, collaborated or supported (i.e., this list is not exhaustive).
(e) Table D-2 includes only those projects that are research grant funded. It excludes projects funded from other sources.
(f) Totals reflect an interim analysis and will be updated in the next ROI reporting cycle. The total number of grants received and number of grant-funded projects are subject to change based on outstanding competitions and funding that crosses fiscal years.
(g) The number of successful research grant applications, or proportion of SCN-led grants, are not accurate measures of SCN performance. The total and SCN role is influenced by factors such as SCN maturity and by specific grant and agency requirements, which may not align directly with SCN priorities.

Appendix E Project-specific information and evaluations

This appendix provides additional details for the 15 projects included in the interim analysis of SCN return on investment. It describes the implementation timeline, data inputs and methods used to evaluate each project and summarizes estimated cost savings and impact.

More detailed information on analytical methods, datasets, calculations and trend analyses is available upon request. Project summary reports, publications and project-specific information are also available on the Alberta Health Services website at www.albertahealthservices.ca/scns/scn.aspx.

Projects

E.1 Hip and Knee Pathway
E.2 Head and Neck Cancer Pathway
E.3 Same-day Mastectomy Pathway
E.4 Stroke Action Plan
E.5 Increased Use of Endovascular Therapy
E.6 Replacement of Inhaled Nitric Oxide Therapy with Epoprostanol (Flolan®)
E.7 Provincial ICU Delirium Initiative
E.8 Basal Bolus Insulin Therapy
E.9 Starting dialysis on Time, At home, on the Right Therapy (START)
E.10 Disinvestment in Fetal Fibronectin Testing
E.11 Disinvestment in Water Bottle Humidification of Oxygen
E.12 Chronic Obstructive Pulmonary Disease Standardized Admission Order Set and Discharge Bundle
E.13 Appropriate Use of Antipsychotics (AUA)
E.14 National Surgery Quality Improvement Program
E.15 Enhanced Recovery After Surgery (ERAS)

E.1 Hip and Knee Pathway

Bone and Joint Health SCN

Overview

Approximately 10,000 elective hip and knee replacements are performed each year in Alberta. To improve patient care and address increased demand for hip and knee surgery, the Bone and Joint Health SCN established local quality improvement teams in all AHS Zones. These teams included patients, families, clinicians, the Alberta Bone and Joint Health Institute and other stakeholders. Together, they developed and implemented standardized clinical pathways across the full continuum of care to improve quality of care for people who experience hip or knee replacement while also improving patient outcomes, efficiency and value across the system.

Implementation

The project has been spread to all surgical facilities performing arthroplasty surgery across Alberta.

2010	Bone and Joint Clinical Network formed. Hip and Knee Arthroplasty Pathway reviewed and five-year implementation plan approved by AHS operations to improve performance and outcomes (including wait times) for this population across 12 Alberta sites. Provincial strategy, including balanced scorecards, launched at 12 sites to support spread and ongoing measurement.
2011	Year 1 of five-year plan begins.
2012	Patient-reported outcome measures included; preliminary results indicate access and quality improvements.
2015	Work transitioned to operations.
2015-present	The Hip and Knee Working Group continue to meet and review progress on a quarterly basis. Physician quality improvement reports and zone improvement reports are circulated several times per year. The clinical committee reviews the pathway and adds new evidence every two years

Evaluation

The impact of the Hip and Knee Pathway on overall costs was assessed based on changes in *hospital length of stay (LOS) per surgery* and in *the percentage of surgeries involving blood transfusion.* We used historical trends to estimate the expected numbers of these variables for patients receiving hip or knee replacement surgery, assuming the pathway had not been implemented. We then compared the expected with the actual numbers to get the changes attributable to pathway implementation.

System costs

System costs for hospital stays and blood transfusions were estimated using provincial costing and data from AHS Finance, Business Advisory Services (BAS) and Data Integration, Measurement and Reporting (DIMR) Services. Unit costs and data sources are listed in Appendix B.

Number of patients impacted

The number of patients impacted by the intervention (84,200) was retrieved from AHS administrative databases and measured from project implementation (April 1, 2010) to March 31, 2019. Note: For this analysis, we extended the evaluation timeline to 2010 to correspond to project implementation, which predates the interval (2012 to March 31, 2018) used for the other 14 projects and described in the main report.

Impact of the intervention

The LOS, percentage of surgeries involving blood transfusion, and the number of surgeries in each fiscal year were retrieved from AHS administrative databases. To determine the impact of the intervention on LOS and the proportion of surgeries involving blood transfusion, we compared actual LOS per surgery (or the percentage of patients requiring a blood transfusion) after the intervention with what would be expected had the intervention not been in place. This trend was determined using a linear regression of data three years before the intervention (for details, see Appendix A, Example 1). Costs or savings were estimated by multiplying the *change in LOS* (in days) due to intervention by the *cost per day,* and by multiplying the *change in the number of blood transfusions* due to intervention by the *cost per blood transfusion*.

Assumptions, limitations and exclusions

Additional benefits (e.g., improvements in patient satisfaction) were not monetized, but are summarized below.

Results

Impact on health system resources and HSU	
Number of patients impacted	84,200
Gross savings per patient	$858
Gross savings for the evaluation period	$72.25 million
Reported outcomes that support these savings:	
➲ Reduced LOS in hospital	Average LOS for hip/knee replacement patients reduced to 2.9 days (2018/19) from 4.3 days (expected), contributing $62.41M in cumulative savings. To date, the pathway has resulted in an estimated 63,879 hospital bed days avoided.
➲ Fewer blood transfusions	The proportion of patients receiving blood transfusions decreased from 22.1% (expected) to 2.0% (2018/19), contributing $9.84M in cumulative savings.
Additional benefits (not monetized within the ROI analysis)	
➲ Increased surgical capacity and productivity	35% more surgeries performed and 9% increase in bed capacity (2010 to 2015).
➲ Fewer readmissions and post-operative complications	Readmissions decreased to 3.9% from 4.7% (2009 to 2015).
➲ Improved patient care and mobilization after surgery	90% of patients out of bed the same day as surgery (2015).
➲ Improved patient experience and satisfaction	Patients and families receive information prior to discharge that supports recovery and prearranges help at home. Patients report increased satisfaction (97%; up from 86% in 2010).

E.2 Head and Neck Cancer Pathway

Cancer SCN, Critical Care SCN and Surgery SCN

Overview

Providing appropriate post-operative care for the head and neck cancer patients is complex and crosses multiple program areas and health disciplines. Coordinating smooth transitions between care providers improves patient outcomes and system efficiencies. The Head and Neck Cancer Pathway is an initiative that brought clinical teams from across the province together to improve the patient experience and address care gaps. The project involved multidisciplinary collaboration by more than 70 stakeholders, including clinicians, operational leads, and frontline staff. It was led by Zone-based surgical programs with support from the Cancer, Critical Care and Surgery SCNs.

The project involved:

1. Reviewing best practices and standards at leading head and neck cancer centres across Canada.
2. Developing provincial components of the pathway and performance metrics.
3. Clinical teams adapting patient care processes to reduce ventilation and sedation, and promote early mobility in the intensive care unit (ICU), and better coordinate care to improve patient outcomes and experiences.

Implementation

This is a highly specialized surgical procedure that is performed exclusively in the two tertiary care centres in the province (located in Calgary and Edmonton).

2014	High observation care guideline implemented at both sites in Alberta that perform all major head and neck cancer surgery (Foothills Medical Centre and University of Alberta Hospital).
2015	10-day standardized inpatient pathway implemented at the University of Alberta Hospital, based on prior successes, including the pathway established at Foothills Medical Centre.
2016	Measurement dashboard report established to support ongoing reporting and continuous improvement.

Evaluation

The impact of the Head and Neck Cancer Pathway on overall costs was assessed based on *ICU length of stay (LOS), hospital LOS,* and *ICU readmissions*. We used Alberta data to compare these variables for patients receiving head or neck cancer care before and after project implementation.

System costs

The cost per hospital bed day was estimated using provincial costing and data from AHS Finance, Business Advisory Services (BAS) and Data Integration, Measurement and Reporting (DIMR) Services. The cost per ICU bed day were estimated based on published data from Tran et al. (2018). Unit costs and data sources are listed in Appendix B.

Number of patients impacted

The number of patients impacted by the intervention (791) from project implementation (Jan 1, 2015) to March 31, 2019 was retrieved from AHS administrative databases.

Impact of the intervention

Impact of the intervention on ICU and hospital LOS and ICU readmissions were retrieved from an Alberta study evaluating the efficacy of the pathway by Barber et al. (2017). This report incorporated the per-patient change in ICU LOS (a reduction of 0.62 days), hospital LOS (a reduction of 6.2 days), and in ICU readmission (a reduction of 8.5%). Costs or savings were estimated by multiplying the *change in LOS* (in days) due to intervention with the *cost per day*. Costs or savings per patient were estimated for each component, then summed for a total impact per patient. This value was multiplied by the number of patients impacted over the evaluation period to calculate gross savings.

Assumptions, limitations and exclusions

Additional benefits (e.g., improvements in patient experience) were not monetized, but are summarized below.

Results

Impact on health system resources and HSU	
Number of patients impacted	791
Gross savings per patient	$8,773
Gross savings for the evaluation period	$6.94 million
Reported outcomes that support these savings:	
➲ Reduced LOS in ICU and hospital	Reduction in ICU LOS (0.62 days) and hospital LOS (6.2 days) per patient as reported by Barber et al. (2017). Other outcomes (not included in this analysis) show the percentage of patients with an ICU LOS less than 24 hours increased from 21% to 80% in Edmonton, and 66% to 89% in Calgary. To date, the pathway has resulted in an estimated 5,522 hospital bed days avoided.
➲ Fewer readmissions, post-operative complications	An 8.5% reduction in ICU readmissions reported following pathway implementation.
Additional benefits (not monetized within the ROI analysis)	
➲ Increased hospital capacity	The pathway has significantly increased capacity (hospital and ICU bed days released to the system) at the University of Alberta Hospital and the Foothills without new resources.
➲ Improved quality and consistency of post-surgical care	Standardized order sets and feedback mechanisms ensure patients receive the same standard of care at all sites facilities across the province. The guideline, developed in Alberta, has become one of the ERAS International Society guidelines and adopted in other countries. Dr. Joe Dort led the development, testing and implementation.
➲ Improved patient and family experiences	Early results reported by the Cancer SCN show that, following pathway implementation, fewer patients required mechanical ventilation after surgery. The percentage of patients breathing on their own upon arrival in the ICU increased from 15% to 80% in Edmonton and from 6% to 31% in Calgary.

E.3 Same-day Mastectomy Pathway

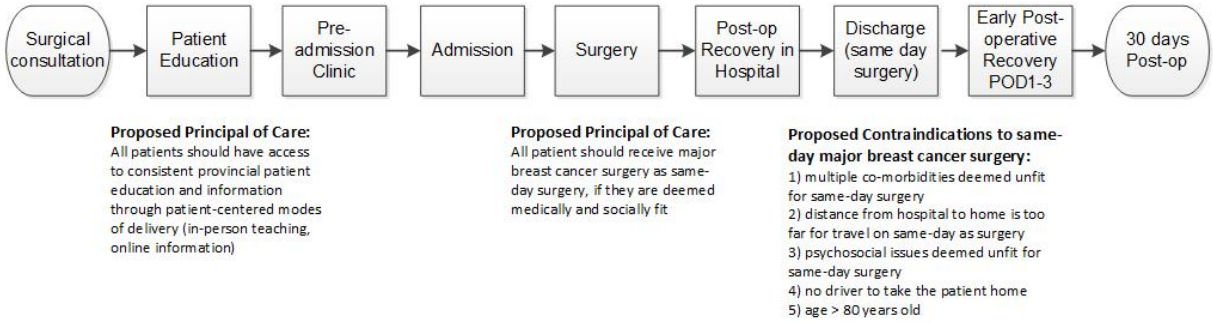
Cancer SCN and Surgery SCN

Overview

In 2011/2012, 98% of Alberta patients undergoing a mastectomy stayed overnight in hospital. Evidence shows that delivering major breast cancer surgery as same-day surgery is safe (no increase in complication rates) and provides a more efficient use of acute care resources. In 2016, the Cancer SCN brought together patients and health partners to evaluate and improve processes for breast cancer diagnosis and surgical care. Using local data, best practices and input from breast cancer survivors, the team designed integrated care pathways to address gaps, streamline processes and improve surgical care.

The Same-day Mastectomy Pathway was developed and implemented as part of the provincial breast health initiative and is the result of successful partnerships between patients, families, clinical teams, administrators, operational leaders, CancerControl Alberta and others. The project involved developing a provincial perioperative patient education package and local outpatient supports to deliver major breast cancer surgery as same-day surgery (i.e., surgery and discharge on same calendar day) in medically and socially fit patients. The pathway was tailored to a local context. The initial target was for 30% of eligible mastectomy patients to receive same-day surgery by March 31, 2018 and 50% by March 31, 2019.

Same-day Mastectomy Pathway



Implementation

The pathway has been implemented at 11 surgical sites across Alberta that perform the majority of major breast cancer surgery in the province (Calgary, Edmonton, Red Deer, Medicine Hat and Lethbridge).

2016–2017	Initial investment supported by the Cancer SCN
2018	Comprehensive perioperative care education package implemented.
	Same-day mastectomy pathway implemented at 11 surgical sites, including Queen Elizabeth II Hospital, Misericordia Community Hospital, Grey Nuns Community Hospital, University of Alberta Hospital, Sturgeon Community Hospital, Red Deer Regional Hospital, Foothills Medical Centre, Peter Lougheed Centre, Rockyview General Hospital, Chinook Regional Hospital, Medicine Hat Regional Hospital.
2019	Ongoing monitoring transitioned to operational site leads.

Evaluation

The impact of the Same-day Mastectomy Pathway on overall costs was assessed based on *measured hospital length of stay (LOS) per surgery*. We used a historical trend to estimate expected LOS for patients receiving mastectomy surgery assuming the pathway had not been implemented. We then compared the expected with the actual numbers to get the changes attributable to pathway implementation.

System costs

The cost per surgical bed day was estimated using provincial costing and data from AHS Finance, Business Advisory Services (BAS) and Data Integration, Measurement and Reporting (DIMR) Services. Unit costs and data sources are listed in Appendix B.

Number of patients impacted

The number of mastectomy surgeries (2,887) was retrieved from AHS administrative databases and measured from project implementation (April 1, 2016) to March 31, 2019.

Impact of the intervention

The average hospital LOS in each fiscal year from 2011/12 to 2018/19 was retrieved from AHS administrative databases. Impact of the intervention on hospital LOS was the difference (change) between the expected values (estimated by a linear regression using the five-year trend prior to the intervention start date) and the actual values observed after the intervention. Cost savings were estimated by multiplying the *change in LOS* per surgery (in days) due to intervention by the *cost per day* and by the *number of surgeries (patients) impacted*.

Assumptions, limitations and exclusions

The evaluation assumes that patients are admitted to general surgery beds following breast cancer surgery and uses a consistent unit cost ($977 per surgical bed day). Additional benefits (e.g., improvements in patient experience) have not been monetized, but are summarized below.

Results

Impact on health system resources and HSU	
Number of surgeries/patients impacted	2,887
Gross savings per patient	$125
Gross savings for evaluation period	$0.36 million
Reported outcomes that support these savings:	
➲ Reduced LOS in hospital	The average reduction in LOS over the evaluation period was 0.39 days. This was largely because the percentage of mastectomies performed as day surgeries increasing from 5% in 2014/16 to 48% in 2018/19 with no increase in complications or readmission rates. To date, the pathway has resulted in an estimated 368 hospital bed days avoided.

Additional benefits (not monetized within the ROI analysis)

- No increase in complications or readmissions

Thirty-day unscheduled ambulatory visits and hospital readmissions rates did not increase with conversion from overnight hospital stay to day surgery pathway with augmented patient education (see table).

Measure	Data – 2018/19
Unscheduled ambulatory visits in 30 days following mastectomy – 2018/19 Q1-3	22% for same-day mastectomies (N = 314) 24% for overnight stays (N = 374)
Non-elective readmissions in 30 days following mastectomy – 2018/19 Q1-3	3% for same-day mastectomies (N = 314) 5% for overnight stays (N = 374)
Post-operative complications in 30 days following mastectomy – 2018/19 Q1-3	8% for same-day mastectomies (N = 314) 10% for overnight stays (N = 374)

- Increased hospital capacity

Shorter length of stay in hospital means beds previously used for surgical recovery are open to other patients.

- Improved patient and family experience

Surgical patients can return home sooner after surgery and report high satisfaction with information received before surgery and at discharge.

Measure	Data – 2018/19
Patient satisfaction with information received before surgery – Jan to Dec, 2018	90% satisfied or very satisfied (N = 162)
Patient satisfaction with information received at discharge – Jan to Dec, 2018	87% satisfied or very satisfied (N = 161)
Patient comfort with going home after surgery – Jan to Dec, 2018	89% felt comfortable (N = 161)
Felt informed on self-care at home (i.e., drain care, incision care) – Jan to Dec, 2018	90% strongly agree (N = 162)

- Contributions outside of Alberta

The guideline developed in Alberta has become one of the ERAS International Society guidelines and adopted in other countries. Dr. Claire Temple Obrely is the surgeon who led the development, testing and implementation.

E.4 Stroke Action Plan

Cardiovascular Health and Stroke SCN

Overview

More than 5,000 Albertans have a stroke each year. It is the leading cause of adult disability and the third leading cause of death. Nearly 15% of people who have a stroke die, and 90% are left with disability, often severe enough to require long-term care. Research shows that when strokes are treated quickly, and when patients receive the right rehabilitation and care following a stroke, they recover faster and have less disability and less need for ongoing care.

The Stroke Action Plan (SAP) is a province-wide effort to address quality of stroke care. It has greatly improved access to high quality stroke care in rural Alberta. Prior to the SAP, stroke unit care was available to only 52% of patients and those in rural and remote areas did not receive the same standard of care as patients in urban centers. The work focused on improving patient outcomes by providing rapid clinical evaluation and treatment, and better coordinating stroke services to ensure all patients had access to comprehensive stroke care and rehabilitation services no matter where they live. Mobile teams were established to bring specialized care to patients in rural areas.

The SAP targeted two main strategies:

1. Developing and implementing provincial standards for Stroke Unit Equivalent Care (SUEC) at rural and small urban primary stroke centers.
2. Coordinating and implementing community-based stroke rehabilitation services, including Early Supported Discharge (ESD) and in-home rehabilitation.

Implementation

The SAP has been implemented provincially.

Mar to Oct 2013	Phase 1 – Project launch; implementation and evaluation of SUEC guidelines and ESD/community rehab (CR) service at pilot site (primary stroke centre in Red Deer).
Oct 2013 to Jul 2014	Phase 2 – Expanded implementation and evaluation of SUEC guideline and ESD/CR to 4 additional primary stroke centres (Camrose, Grande Prairie, Medicine Hat and Lethbridge) (5 total)
Jan 2014 to Dec 2015	Phase 3 – Expanded implementation and evaluation of SUEC guidelines to include remaining 9 primary stroke centres.
Dec 2015	Project closure and transition to operations for all 14 participating sites

Evaluation

The impact of the SAP on overall costs was assessed based on *the number of stroke cases treated with Stroke Unit Equivalent Care (SUEC) and with SUEC + Early Supported Discharge (ESD) strategies* and the incremental costs or savings of these strategies compared to existing care practice (prior to SAP implementation).

System costs

The cost per stroke was estimated using AHS provincial costing and data from Alberta Health, AHS Finance, Business Advisory Services (BAS) and Data Integration, Measurement and Reporting (DIMR) Services as well as information published by Zheng et al. (2019). Unit costs and data sources are listed in Appendix B.

Number of patients impacted

The number of stroke cases treated with SUEC (5,994) and with SUEC+ESD (870) was retrieved from AHS administrative databases and measured from project implementation to March 31, 2019.

Impact of the intervention

According to Zhang et al. (2019), a stroke treated with SUEC saved $3,177 in healthcare costs, and strokes treated with SUEC+ESD cost $2,325 more per patient compared to current practice (because of additional home care and community rehab services) but also produced better patient' outcomes relative to standard care. We estimated the gross benefits of the SAP by multiplying the number of strokes treated with SUEC and savings per patient and subtracting the additional costs of providing SUEC+ESD.

Assumptions, limitations and exclusions

Additional benefits (e.g., improvements in quality of life) have not been monetized, but are described below.

Results

Impact on health system resources and HSU	
Number of patients impacted	6,864
Gross savings per patient	$2,479
Gross savings for evaluation period	$17.02 million
Reported outcomes that support these savings:	
➲ Reduced LOS in hospital, disability and need for long-term care	ESD with in-home rehabilitation enables patients to return home sooner with fewer admitted to long-term care. These changes significantly impact the availability of acute care beds and long-term care beds, increasing hospital capacity while improving patient care. Outcomes reported by the Cardiovascular Health and Stroke SCN indicate a 1-day reduction in median LOS and 28% decrease in patients admitted to long-term care. To date, the SAP has resulted in an estimated 18,466 hospital bed days avoided.
➲ Improved patient outcomes	Stroke survivors treated with SUEC and ESD demonstrated clinically significant and meaningful improvements in their functional abilities.
Additional benefits (not monetized within the ROI analysis)	
➲ Improved access and quality of care	Patients in rural and remote areas now receive the same standard of care as patients who live in urban centers. Prior to the SAP, some patients waited in hospital up to 10 days to receive rehabilitation. Today, 88.2% of people receive an initial rehabilitation assessment within 48 hours (up from 57.7%).
➲ National recognition as a leader in health improvement	Alberta has become a leader in stroke care as a result of sustained efforts by operational leaders, frontline staff, therapists and all health partners. The SAP team has received national recognition for this work and received the 2014 Canadian Stroke Congress Co-Chair's Award for Impact.

E.5 Increased Use of Endovascular Therapy

Cardiovascular Health and Stroke SCN

Overview

Endovascular therapy (EVT) is a stroke treatment that removes the large stroke-causing clots from the brain, and substantially improves the chance for a better outcome for patients. There is compelling evidence to show that EVT saves lives and can dramatically reduce disability for large, disabling strokes.

The Cardiovascular Health and Stroke SCN has been working with stakeholders from across the province, including EMS, STARS, Emergency Medicine, Zone Stroke Program administrative and stroke neurology and neuro-radiology leads, to adapt Alberta's stroke system of care. One of their goals is to improve access to EVT across the province. Prior to 2017, EVT was available to only those Albertans in Calgary and Edmonton at the two Comprehensive Stroke Centres.

This project increased timely, equitable and safe access to EVT by revising existing transportation pathways and protocols and implementing processes that reduce time to treatment and make EVT accessible to all Albertans. This included:

1. Revising EMS triage and transport pathways and inter-hospital referrals.
2. Implementing appropriate brain scans in remote stroke centres to assess patients' eligibility for EVT.
3. Improving care processes to reduce the time to treatment.

Operating as a single provincial health system provided an advantage in achieving these objectives.

Implementation

The project has been implemented across Alberta.

2015	The preliminary ESCAPE trial (led by Alberta investigators) showed a 50% reduction in mortality and 31% absolute improvement in good functional outcomes with EVT. The SCN held broad stakeholder meeting to determine potential for increasing access to EVT across Alberta.
2016	ESCAPE trial stopped because outcomes were substantially better with EVT.
2017	Provincial access to EVT fully implemented in April 2017; funding for increased EVT procedures, including imaging procedures, was approved by ELT in June 2017
2019	New evidence shows the benefit of EVT for patients in the extended time window from 6 to 24 hours. A feasibility assessment is underway with all stakeholders to determine requirements to expand the time window for EVT from 6 hours to 24 hours.

Evaluation

The impact of the EVT on overall costs was assessed based *on the increase in the number of stroke patients who receive EVT* compared to the pre-intervention volumes. The incremental costs or savings per EVT patient were based on patients in the ESCAPE trial who received EVT, compared to those who did not.

System costs

The incremental costs or savings for treating a stroke using EVT (compared to conventional care) was retrieved from an analysis conducted by the Cardiovascular Health and Stroke SCN (2019), where the one-year savings per EVT patient was estimated at $42,287 (of which, inpatient rehabilitation accounted for 88.8% of this cost, continuing care 7.3%, acute care 2.9%, and sub-acute care 0.9%).

Number of patients impacted

The number of EVT patients impacted by the intervention was estimated by comparing the actual to the expected numbers of EVT patients from the intervention start to March 31, 2019. The actual number was retrieved from AHS administrative databases. The expected number for each fiscal year (if the intervention had not been in place) was estimated by averaging 2 years of data on EVT cases prior to intervention start.

Impact of the intervention

The change (difference) between the actual and the expected numbers of EVT patients was the impact of this intervention. We multiplied the number of EVT patients with the savings per EVT patient to calculate total savings

Assumptions, limitations and exclusions

Additional benefits (e.g., improvements in quality of life) have not been monetized, but are described below.

Results

Impact on health system resources and HSU	
Number of patients impacted	174
Gross savings per patient	$42,286
Gross savings for evaluation period	$7.36 million
Reported outcomes that support these savings:	
➲ Cost avoidance resulting from improved access to EVT therapy, quality of care and improved patient outcomes	Since launching this program, the number of EVT patients has increased by 38%, and access to this therapy has more than doubled in non-urban zones. One-year savings per EVT patient estimated at $42,487, including costs of rehabilitation, continuing care, acute care and sub-acute care). To date, this work has resulted in an estimated 5,987 hospital bed days avoided. Patients who receive EVT have lower rates of mortality, disability and need for long-term care. Alberta data shows that people who receive EVT after a stroke have better outcomes. Twice as many returned to functional independence and half as many died, compared to those who did not receive the treatment.
Additional benefits (not monetized within the ROI analysis)	
➲ Improved quality of life and patient, family and provider experience	Improvements in care and patient outcomes translate to less long-term disability and improved quality of life following stroke.

E.6 Replacement of Inhaled Nitric Oxide Therapy with Epoprostanol (Flolan®)

Critical Care SCN

Overview

Inhaled nitric oxide (iNO) therapy is a treatment for patients with extremely low blood oxygen levels or severe heart failure. Between 2005 and 2014, AHS saw a cost increase in the use of iNO of 1,366%. Evidence shows that more cost-effective treatment alternatives, such as Epoprostanol (Flolan®), are appropriate in some clinical conditions. Understanding the appropriate use of iNO and alternative forms of treatment is critical to ensure consistent patient care and ensure best value.

The iNO project was led by the Critical Care SCN with the support of Zone operations. The work involved:

1. Understanding the evidence around use of alternative treatments such as Epoprostanol (Flolan®).
2. Creating provincial standards to guide staff on the appropriate use of iNO and Epoprostanol (Flolan®) at hospitals across the province.
3. Implementing changes in practice that reflect these standards using a phased approach that incorporates feedback from front-line staff throughout the process.

Implementation

The project has been spread to all intensive care units (ICU) across Alberta

2013	Developed draft provincial standards for iNO and Flolan® use
Spring 2014	Phase 1 - Piloted proof of concept in three intensive care units (University of Alberta Hospital, Royal Alexandra Hospital and Mazankowski Hospital in Edmonton).
Fall 2014	Phase 2 - Spread to ICUs at Foothills Medical Centre (ICU and CVICU) and the Peter Lougheed Centre in Calgary.
Spring 2015	Provincial rollout in all ICUs.

Evaluation

The impact of the iNO project on overall costs was assessed by comparing *savings and costs due to switching from iNO therapy to Epoprostanol (Flolan®)* in adult ICUs in Alberta.

System costs

The unit costs per iNO hour before ($95.67) and after ($33.49) the 2017 contract effective date (March 1, 2017) were estimated using data provided by the AHS Contracting, Procurement and Supply Management (CPSM) Services. Using the Epoprostanol (Flolan®) cost of $37 per vial (AHS Drug Information, Utilization and Stewardship) and assuming that one vial (1.5mg) would last about 6-7 hours given at a dose of 50ng/kg/min (personal communication with Dr. Bagshaw, Professor and Chair, Department of Critical Care Medicine, University of Alberta), the cost per Epoprostanol hour was conservatively estimated at $6.17.

Number of patients impacted

The evaluation is based on the number of hours patients received iNO and/or Epoprostanol (Flolan®) therapy. This data was obtained from AHS administrative databases, and is not based on the number of patients impacted. Likewise, savings are reported cumulatively over the evaluation period until March 31, 2019.

Impact of the intervention

The impact of this intervention was evaluated by calculating the difference between *savings due to the reduction of iNO hours* and *costs due to the increase of its replacement (Epoprostanol (Flolan®))* in adult ICUs. Savings (due to reduction in iNO hours) were calculated by multiplying the number of hours iNO were reduced after the intervention with the cost per iNO hour. The costs (due to the increase in Epoprostanol (Flolan®) hours) were calculated by multiplying the number of hours Epoprostanol (Flolan®) hours increased after the intervention with the cost per Epoprostanol hour.

The number of iNO hours reduced (6,818 hours before, and 5,372 hours after, March 1, 2017 [date the new pricing contract was in effect; see unit costs in Appendix B], and the number of Epoprostanol (Flolan®) hours increased (56,221) were estimated from AHS administrative databases and measured from project implementation to March 31, 2019.

Assumptions, limitations and exclusions

Additional benefits (e.g., improvements in health outcomes) have not been monetized, but are described below.

Results

Impact on health system resources	
Number of patients impacted	—
Gross savings per patient	—
Gross savings for evaluation period	$0.49 million
Reported outcomes that support these savings:	
➲ Cost avoidance through adoption of more cost-effective treatment alternative, where appropriate	By removing practices that do not provide high value, AHS has improved its use of health system resources. Patients receive high quality, appropriate care while optimizing value and health system sustainability.
Additional benefits (not monetized within the ROI analysis)	
➲ Improved consistency of care, patient and provider experience	Provincial standards assist care providers in identifying and using the most appropriate treatment alternative to support high-value care.

E.7 Provincial ICU Delirium Initiative

Critical Care SCN

Overview

Approximately 12,800 patients are treated in Alberta intensive care units (ICUs) each year. Because of their severe illness and the need for life support (e.g., breathing machines) and aggressive treatment, about 2 out of 3 patients admitted to the ICU experience delirium. This often occurs within days of their ICU admission and can be very unsettling for patients and their families. Delirium also extends ICU stays and complicates treatment. Although delirium is usually temporary, the effects can be debilitating and long-lasting.

In 2015, the Critical Care SCN, along with operational leaders and frontline clinicians, identified delirium as a top priority to improve quality of care in ICUs. Practitioners across the province came together to share their knowledge and develop solutions that reflected the best available evidence. The goal was to identify ways to prevent ICU delirium and improve health outcomes.

The project involved developing provincial standards for managing pain, sedation and ICU care that would prevent or reduce delirium; help care providers identify and manage delirium; and reduce the risk of long-term impacts on patients' function and quality of life. They used eCritical, the electronic medical record repository for all Alberta ICUs, and developed a dashboard to better monitor patient agitation, sedation, mobility and delirium symptoms; track patient outcomes; and evaluate ICU performance.

Implementation

The initiative has been spread to all ICUs across Alberta.

Sep 2016	Creation of Provincial Delirium Network
Nov 2016	Implementation of best practices began across all 21 ICUs
Apr 2019	Provincial adoption and ongoing sustainability of clinical best practices for delirium screening, early mobilization, improved pain management, and improved sedation, thus reducing the number of critically ill patients with delirium across Alberta.

Evaluation

The impact of the Provincial ICU Delirium Initiative on overall costs was estimated based on the *number of delirium cases prevented by the intervention* and the *additional cost of managing patients with delirium per case*.

System costs

The incremental cost per case of ICU delirium ($7,618) compared to non-delirium was retrieved from Cole and Osiowy (2019). Unit costs and data sources are listed in Appendix B.

Number of patients impacted

The number of ICU delirium cases (684) prevented by the intervention from project implementation to March 31, 2019 was retrieved from Cole and Osiowy (2019).

Impact of the intervention

Impact of the intervention on the number of delirium cases in the ICU was the difference between the expected numbers (estimated by a linear regression using data from Oct 2015 to Jan 2017) and the actual numbers observed after the intervention. It was estimated that 684 cases of ICU delirium were prevented in Alberta ICUs from February 1, 2017 to March 31, 2019 (Cole and Osiowy (2019). The estimated number of cases of ICU delirium prevented was multiplied by the incremental cost per case to calculate total savings.

Assumptions, limitations and exclusions

Additional benefits (e.g., improvements in health outcomes and patient experience) have not been monetized, but are described below.

Results

Impact on health system resources and HSU	
Number of delirium cases prevented	684
Gross savings per patient	$7,618
Gross savings for evaluation period	$5.21 million
Reported outcomes that support these savings:	
➲ Reduction in the number of critically ill patients who experience ICU delirium	Improved standards support ICU care providers in identifying and managing ICU delirium, managing pain and sedation, and providing ICU care that prevents or reduces ICU delirium. 10% decrease in the reported number of days patients experience ICU delirium.
➲ Reduced LOS in ICU and hospital	Delirium extends ICU stays and complicates treatment. Reducing the number of ICU delirium cases contributes to shorter LOS in acute care. To date, this work has resulted in an estimated 1,306 hospital bed days avoided.
Additional benefits (not monetized within the ROI analysis)	
➲ Improved quality and consistency of ICU delirium care	All patients admitted to an ICU now receive care that is consistent with delirium best practices. Clinicians have consistent standards and an operational dashboard to better monitor patients, track outcomes and evaluate ICU performance. Risks to patient safety have also decreased. Patients are spending fewer days on a breathing machine and being monitored more frequently and consistently.
➲ Improved outcomes and patient and family experiences	Reducing ICU delirium contributes to improved recovery and reduces the risk of long-term impacts on patients' function and quality of life. Patients, families and friends also now have better information about ICU delirium, what to expect and how to support recovery once the patient returns home.
➲ Improved experience for care providers	Reduction in ICU delirium means fewer confused and disoriented patients. This improves the experience of care providers and positively contributes to staff satisfaction and wellness.

E.8 Basal Bolus Insulin Therapy

Diabetes, Obesity and Nutrition SCN

Overview

People with diabetes are often admitted to hospital for reasons other than their diagnosis of diabetes. Approximately 20% of all adult patients in Alberta hospitals have diabetes, and more than one-third of blood sugar levels are above the recommended target (5-10 mmol/L) in Alberta hospitals. High blood sugar (above 10 mmol/L) is associated with an increase in complications such as infection, delayed wound healing, and extended the length of stay (LOS), readmission and patient mortality.

A common unwarranted practice for managing diabetes and high blood sugar in hospital is the use of Sliding Scale Insulin Therapy. This approach treats high blood sugars reactively rather than preventing highs in the first place. Basal Bolus Insulin Therapy (BBIT) is a proactive approach that aims to anticipate patients' insulin needs and improve blood sugar control to keep blood sugars in a safe range (5-10 mmol/L), as recommended by Diabetes Canada clinical practice guidelines. BBIT is customized to the unique needs of each patient and has been shown to reduce high blood sugars in hospitals without increasing episodes of low blood sugars (below 4 mmol/L).

The SCN worked with health partners to improve clinical practices and better support patients in maintaining their blood sugars while in hospital. The project involved:

1. Working with operational teams to standardize insulin ordering practices and develop a provincial policy to support glycemic management in hospital.
2. Creating educational tools to support evidence-based clinical best practice around insulin ordering.
3. Working with provincial Nutrition and Food Services to ensure carbohydrate information is available to patients on hospital menu items.
4. Supporting the provincial Pharmacy with the simplified insulin formulary and promoting patient-specific insulin dispensing.
5. Implementing changes in practice at hospitals across the province to reflect these standards.

Implementation

The project has been spread to hospitals in four out of five AHS Zones across Alberta.

2015–2018	The SCN supported seven early adopter sites interested in improved glycemic management, including BBIT across Alberta. Sites included: Chinook Regional Hospital (Lethbridge); Canmore General Hospital (Canmore); Oilfields General Hospital (Black Diamond); the Calgary Hospitalist program at Foothills Medical Centre, Rockyview General Hospital, Peter Lougheed Hospital and South Health Campus (Calgary); the University of Alberta Hospital, Grey Nuns Community Hospital (Edmonton); and Queen Elizabeth II Hospital (Grande Prairie). These early adopters informed an implementation strategy that AHS and Covenant Health care providers could use to implement BBIT ordering and improve glycemic management care.
2017–2019	Basal bolus insulin ordering has been implemented in acute care sites across the South Zone, Calgary Zone, Central Zone, and Edmonton Zone. North Zone acute care sites have identified basal bolus insulin ordering a priority in 2019.

Evaluation

The impact of BBIT was assessed based on *hospital length of stay (LOS)* for people with diabetes. We used Alberta data to compare hospital LOS for patients with diabetes before and after project implementation.

System costs

System costs for hospital stays were estimated using provincial costing and data from AHS Finance and Business Advisory Services (BAS). The hospital cost per patient per day (for patients with diabetes) was estimated to be $1,147. Unit costs and data sources are listed in Appendix B.

Number of patients impacted

The number of patients impacted by the intervention (11,106) was retrieved from AHS administrative databases and measured from project implementation to March 31, 2019.

Impact of the intervention

Impact of the intervention on hospital LOS was the difference between the expected (baseline) value and the LOS following the intervention. This was determined based on Alberta data as reported by Rogers (2019), who used a multiple regression with a log-normal transformed LOS (due to skewness) to compare a cohort of patients admitted before the intervention to a cohort of patients admitted after the intervention. The analysis by Rogers (2019) showed that hospital LOS was reduced by one day for patients receiving BBIT. Costs or savings of the BBIT project were estimated by multiplying the change in hospital LOS per patient by the number of patients impacted over the evaluation period and by the cost per hospital day.

Assumptions, limitations and exclusions

Additional benefits (e.g., improved outcomes and patient care) have not been monetized, but are described below.

Results

Impact on health system resources and HSU	
Number of patients impacted	11,106
Gross savings per patient	$1,147.52
Gross savings for evaluation period	$12.74 million
Reported outcomes that support these savings:	
➲ Reduced LOS in hospital	For patients with diabetes, BBIT is estimated to reduce the hospital LOS by 1 bed day per patient, for an estimated 11,106 hospital bed days avoided to date.

Additional benefits (not monetized within the ROI analysis)	
➲ Improved quality, safety and consistency of care	Since implementation, care has become more patient-centered and proactive. Patients with diabetes are safer due to reduced rates of hyperglycemia and hypoglycemia and fewer complications. Early data indicates a significant increase in the number of days patients spend in the recommended blood sugar target zone.
➲ Improved outcomes, patient and family experiences and satisfaction	With lower rates of hyperglycemia and hypoglycemia and fewer complications, patients have a better experience while in hospital and can return home sooner. They also have information to help control their own blood sugar while in hospital.
➲ Increased hospital capacity	Due to shorter hospital stays (1 bed day per patient), fewer complications and reduced readmissions, BBIT freed up more than 11,000 bed days in early adopter hospitals. This represents approximately one-third of Alberta acute care hospitals.

E.9 Starting dialysis on Time, At home, on the Right Therapy (START)

Kidney Health SCN

Overview

The demand for dialysis therapies in Alberta has increased at a rate of 4.5% per year, placing significant capacity and financial pressures on Alberta's renal programs. There are more than 2,200 patients in Alberta who currently receive dialysis for end-stage kidney disease, and approximately 600 new patients begin dialysis therapy each year. Most patients with kidney failure are treated with in-centre hemodialysis (HD), despite the fact that peritoneal dialysis (PD) provides similar outcomes and is much less expensive to provide. And while guidelines suggest patients should not initiate dialysis until they develop symptoms, many patients start dialysis earlier than is recommended.

The Kidney Health SCN developed the START Project in partnership with Alberta Kidney Care to address these care gaps. A structured review process was implemented to ensure all new dialysis patients were: identified and assessed for PD eligibility; educated about treatment options and offered PD if they were eligible; supported to make an informed modality decision; and successfully initiated on their chosen therapy. The START project aimed to achieve (i) a 5% absolute increase in the proportion of patients who receive PD within 180 days of starting dialysis province-wide; and (ii) a 5% absolute reduction in the proportion of outpatients who initiate dialysis with an eGFR greater than 9.5 mL/min/1.73 m^2.

Implementation

The guidelines and tools developed as part of the START Project have been implemented province-wide. This included a patented Dialysis, Measurement, Analysis and Reporting System (DMAR™ System) that supported high-quality data collection.

Mar to Oct 2016	Phase 1 – Expanded on success of Calgary Zone Pilot Project (Jan 2013-Dec 2014); scaled processes for data collection, sharing and treatment modality selection across the province to all 7 multidisciplinary chronic kidney disease clinics in Alberta. Participating sites included: Calgary, Lethbridge, Medicine Hat, Edmonton (including University of Alberta Hospital, Grey Nuns Community Hospital, and Royal Alexandra Hospital), and Red Deer
Oct 2016 to Mar 2018	Phase 2 – Structured review of all new dialysis patients, and developed and implemented reporting of metrics tied to modality selection and dialysis initiation.
Jun 2017 to Mar 2018	Phase 3 – Quality improvement process, audit and feedback and local interventions.

Evaluation

The impact of the START project on overall costs was assessed based on the *number of new patients with kidney failure who received PD, and who initiated dialysis early, and on the costs or savings per patient*.

System costs

The total health care cost differential for a patient with chronic kidney disease treated with PD was conservatively estimated to be $25,000 less per year compared to a patient treated with HD.

Using a decision analytic modelling technique to compare a one year cohort of patients managed within the START project with a one year historical cohort, Manns and Au (2019) estimated that the net cost-savings over a period of one year was $1,273,640, taking into account the cost of the START initiative itself ($397,820 annually). We divided this number (1,273,640) by the number of patients in a one year cohort (626) to estimate the gross savings per patient at $2,670.

Number of patients impacted

According to Manns and Au (2019), there were 939 patients impacted by the intervention in the 1.5-year evaluation period (from October 1, 2016 to March 31, 2018). Proportionately, we estimated that the number of patients per year was 626. By March 31, 2019, a total of 1,565 patients were impacted by START intervention.

Impact of the intervention

The impact of the START project was estimated by multiplying the savings per patient treated with START with the number of patients impacted by START.

Assumptions, limitations and exclusions

In this analysis, we assumed that cost savings occurred only for one year, but since patients on PD will continue on PD for more than one year, this is a very conservative assumption. This impact was tested in longer-term analyses, but not included in the savings reported here. We assumed the risk of PD failure (requiring conversion to hemodialysis) remained the same after the intervention compared with before.

Additional benefits (e.g., improvements in quality of life) have not been monetized, but are described below.

Results

Impact on health system resources and HSU	
Number of patients impacted	1,565
Gross savings per patient	$2,670
Gross savings for evaluation period	$4.18 million
Reported outcomes that support these savings:	
➲ Increase in the proportion of patients with chronic kidney disease who receive PD	Since launching the START project, the percentage of patients province-wide who received PD within the first 180 days of starting dialysis increased from 25% to 32% ($p<0.001$) during the evaluation period, with 6 out of 7 sites showing growth.
➲ Appropriate timing for dialysis initiation	Prior to the START Project, data from Alberta indicated that 16% of patients with kidney failure were starting dialysis earlier than recommended (2013). This number has since decreased to 13% (2018) (Note: A lower percentage represents better performance.)

Additional benefits (not monetized within the ROI analysis)	
➲ Improved health system capacity and flow	Improving access to PD for eligible patients can help relieve capacity pressure for in-centre hemodialysis. This increases capacity for patients who are not eligible, or who choose not to receive PD, and delays the need for capital spending to expand in-centre hemodialysis services.
➲ Improved quality of life and patient and family experience	In-centre hemodialysis requires a large time commitment and can adversely impact patients' quality of life. Since the START Project, the proportion of new patients being treated in their homes has increased by 7% province-wide. For these patients, this means more time at home and in their community, reduced travel expenses, increased leisure and work time, and improved quality of life.
➲ Recognition as a leader in health improvement	Alberta has become a leader in kidney care as a result of sustained effort and commitment by operational leaders, frontline staff, and all health partners. The START Project team was recognized for this work and received the 2018 AHS President's Award for Excellence in Quality Improvement.

E.10 Disinvestment in Fetal Fibronectin Testing

Maternal, Newborn, Child and Youth SCN

Overview

In 2006, fetal fibronectin testing was implemented across Alberta for women showing symptoms of preterm labour. This decision reflected the best evidence available at the time. The goal was to more accurately assess the risk of preterm labour and to avoid preterm births in rural hospitals without the resources to care for preterm births, and unnecessary hospital admissions and urgent transfers.

In 2016, the Institute for Health Economics examined new evidence, which revealed that fetal fibronectin testing had made no difference in hospital admission patterns. Although the test was convenient, there was no evidence that it reduced preterm births, improved outcomes or provided value. This was consistent with new published evidence showing that results are not always reliable, with low specificity, meaning that many expectant mothers were needlessly transferred to hospitals with a higher level of care.

The Maternal, Newborn, Child and Youth SCN was asked to evaluate the practice and make an evidence-informed recommendation regarding the continued use of fetal fibronectin testing in Alberta. The network brought together a diverse team to review available research, evaluate nine years of data on preterm births in Alberta (2010–2018) and current practices for assessing risk of preterm births in rural and urban communities. The team recommended that fetal fibronectin testing be discontinued in Alberta as up-to-date evidence showed no benefit to patient safety or outcomes for mothers and their babies. It identified opportunities to improve clinical assessments and developed a guideline and decision aid to help clinicians assess the risk of preterm birth without laboratory testing. To ensure there were no unintended consequences resulting from this change, practitioners continued monitoring how preterm labour is managed in rural hospitals to ensure no adverse impact of discontinuing testing on preterm births.

Implementation

Fetal fibronectin testing was discontinued across Alberta in 2016 and testing devices were removed from all sites.

Jul 2016	Fetal fibronectin (fFN) testing discontinued, effective July 1, 2016.
Aug 2016	Development and implementation of two guidelines: (i) The Clinical Assessment of 'At Risk' or Actual Preterm Labor for Triage (clinical guideline and related clinical decision-making tools) and (ii) The Obstetrical Triage Acuity Scale (OTAS) clinical practice guideline, health care provider education and clinical documentation processes.
Oct 2016	Effective discontinuation of fFN testing, achieved through the removal of fetal fibronectin from lab ordering options and removal of testing supplies and equipment from all facilities in both AHS and Covenant Health sites.
May 2019	Evaluation of preterm birth data comparing approximately six years before fFN was discontinued to approximately 2.5 years after. Results indicated no discernible difference in admission and transfer patterns or patient outcomes.

Evaluation

The impact of disinvestment on fFN testing on overall costs was assessed based on *cost avoidance due to the discontinuation.*

System costs

The cost per patient for fFN testing ($319) were retrieved from Chuck et al. (2016) using AHS data, which includes the cost of the test ($136) as well as costs ($183) for changes in health service utilization impacted by fFN testing (e.g., ambulance transfers, hospital admissions, hospital length of stay, and associated health services).

Number of patients impacted

The number of patients impacted by the intervention (6,186) from July 1, 2016 to March 31, 2019 was proportionately calculated using the number of patients (13,131) in the evaluation period (5.8 years) reported by Chuck et al. (2016).

Impact of the intervention

The impact of this intervention was evaluated by calculating the expected costs of fFN testing from July 1, 2016 to March 31, 2019 (2.75 years) had it not been discontinued. The expected costs were calculated by multiplying the costs per patient (mentioned above) with the number of patients who would have been impacted during this period.

Assumptions, limitations and exclusions

Additional benefits (e.g., patient safety and experience) have not been monetized, but are described below.

Results

Impact on health system resources	
Number of patients impacted	6,186
Gross savings per patient	$318.03
Gross savings for evaluation period	$1.97 million
Reported outcomes that support these savings:	
➲ Cost avoidance through clinical practice change that reflects the best available evidence	By discontinuing practices that do not provide value, AHS has improved is use of health system resources.

Additional benefits (not monetized within the ROI analysis)	
➲ No change in patient safety, urgent transfers and referrals, or rate of preterm births	Since fetal fibronectin testing has been discontinued, there has been no significant change in the rate of preterm deliveries in rural hospitals or referrals and urgent transfers of rural patients to urban hospitals.
➲ Improved patient, family and provider experience	Expectant mothers and their families can be confident they are receiving quality, evidence-based care. Likewise, care providers have the tools they need to make effective decisions and provide safe, high-value care.

E.11 Disinvestment in Water Bottle Humidification of Oxygen

Respiratory Health SCN

Overview

Evidence from around the world increasingly showed that pre-filled water bottle humidification of oxygen is not an effective therapy for adults. The risk of misconnections is high and it can disrupt oxygen flow in some patients. AHS issued a Patient Safety Alert in 2013 based on incidents reported in the Reporting and Learning System for Patient Safety (RLS). In response, the Respiratory Health SCN partnered with the Health Professions Strategy & Practice to evaluate current clinical practice. Together they developed a Professional Practice Notice and orientation toolkit to discontinue the practice of using pre-filled water bottles for humidification of oxygen for adults.

Eliminating the use of these pre-filled water bottles for adult patients reduces the risk of misconnection and improves patient safety. As a result of this work, AHS no longer uses pre-filled water bottles for humidification of oxygen therapy for adults and there have been no additional RLS reports regarding loss of oxygen supply due to water bottle humidification of oxygen since discontinuing this practice.

Implementation

This change in clinical practice was implemented province-wide February 4, 2016. Audits confirm that pre-filled water bottles are no longer being purchased or used for adult patients.

Oct 2013	AHS Patient Safety Alert issued asking for immediate action regarding proper use of humidifier bottles to avoid obstruction of oxygen flow to adult patients using this therapy. Despite the alert and follow-up, adverse events continued.
May 2014	Respiratory Health SCN launches and works with operational partners to review best practices and current evidence regarding the safety and value of this practice and recommend action and mitigation options.
Nov 2015	Report and recommendations presented to AHS Quality and Safety Executive Committee (QSEC) and AHS Clinical Operations Executive Committee (COEC).QSEC and COEC approve plan to discontinue this practice across the province. The SCN worked with AHS Contracting, Procurement & Supply Management (CPSM) to mitigate financial impacts of this decision, develop a transition plan with vendors and a communications plan to support efficient removal of supplies from all sites.
Feb 2016	Professional Practice Notice and education toolkit released. Practice discontinued at all sites and settings for patients over age 18.
May 2016	Support and follow-up as needed; full-scale implementation confirmed at all sites.

Evaluation

The impact of no longer using or purchasing pre-filled water bottles for humidification of oxygen in adults was assessed based on *cost avoidance*. The savings are equal to the cost of pre-filled water bottles for oxygen dehumidification that would have been expected if the practice had not been discontinued.

System costs

Based on data from AHS Finance and Business Advisory Services (BAS), AHS spent about $235,579 per year before this practice was discontinued for adult patients and $22,698 per year after project implementation (to support pediatric care).

Number of patients impacted

The evaluation is not based on the number of patients impacted.

Impact of the intervention

The impact of this intervention was the difference in costs purchasing the water bottles before and after the discontinuation. We estimated the impact per year, and then extrapolating it proportionately for the period from February 1, 2016 to March 31, 2019.

Assumptions, limitations and exclusions

Consistent with published evidence, we assumed that health outcomes and health services utilization of the patients were not impacted by this intervention.

Additional benefits (e.g., patient safety and experience) have not been monetized, but are described below.

Results

Impact on health system resources	
Number of patients impacted	—
Gross savings per patient	—
Gross savings for evaluation period	$0.67 million
Reported outcomes that support these savings:	
➲ Cost avoidance through clinical practice change that reflects the best available evidence	By discontinuing practices that do not provide value, AHS has improved is use of health system resources.

Additional benefits (not monetized within the ROI analysis)	
➲ Improved patient safety	Use of pre-filled water bottles to humidify supplemental oxygen therapy provided no benefit to adult patients, and there was a risk of misconnection, which could cause adverse events. Since implementing this change, there have been zero safety reports related to this issue and no operational concerns regarding this change in practice.
➲ Improved consistency of care, patient and provider experience	Provincial standards help providers identify and use the most appropriate treatment alternative to support high-value care.

E.12 Chronic Obstructive Pulmonary Disease Standardized Admission Order Set and Discharge Bundle

Cardiovascular Health and Stroke SCN and Respiratory Health SCN

Overview

Chronic Obstructive Pulmonary Disease (COPD) is a common, complex and progressive chronic disease, and is the sixth leading cause of mortality for Canadians aged 35 years and older. Patients with heart failure and COPD account for the highest hospital admission rates of all chronic diseases in Alberta. Individuals with these conditions experience long hospital stays, and frequent readmissions to hospital and emergency room visits. Sudden worsening of COPD symptoms account for the largest number of preventable hospital admissions compared to all other chronic diseases.

A provincial initiative is underway to implement and evaluate evidence-based clinical pathways for heart failure and COPD. The objective is to improve care across the continuum from hospital admission through discharge into the community and primary care settings. This work is supported by the SCNs and the COPD and Heart Failure provincial working group and seeks to coordinate and standardize care, reducing variability in clinical practice and improving health outcomes. Two components of this project are evaluated here:

1. COPD Standardized Admission Order Set, which involved developing and implementing standardized admission order sets based on best practice.
2. COPD Standardized Discharge Bundle, which involved developing and implementing components of the Standardized Order Set that focus on discharge; specifically (1) a discharge management plan (DMP); (2) patient education resource package, and (3) admission-to-discharge checklist, based on best practice.

Implementation

The project has spread to 15 acute care sites and partner primary care networks across five AHS Zones. What began as a small-scale effort to address the challenges faced by COPD patients and their families has grown into a partnership between acute and primary care, researchers and community providers on a provincial scale.

2014-2015	Respiratory Health SCN launches and works with health providers to build an integrated COPD pathway that spans the continuum of care.
2016	AHS Executive Leadership Team approves the implementation plan for the acute care admission order set and the discharge bundle. Red Deer Regional Hospital (Central Zone) is the first site to implement both.
2016-present	Rollout has expanded across all 5 AHS Zones, with 15 acute care sites and partner primary care networks at various stages of implementation. Data collection and analysis is shared with frontline teams through clinical dashboards. Work is currently underway to build the COPD pathway and its critical components into Connect Care.

Evaluation

The impact of the COPD Standardized Admission Order Set on overall costs was assessed based on *measured hospital length of stay (LOS) shortened by COPD admission order set implementation.* The impact of the COPD

Standardized Discharge Bundle on overall costs was assessed based on the *number of readmissions* prevented by project implementation.

System costs

The cost per hospital day for COPD ($1,203) was estimated using Alberta data from Tran et al. (2019). The cost per readmission of COPD patients was assumed equal to the cost per COPD hospitalization ($12,994) reported by Tran et al. (2019). Unit costs and data sources are listed in Appendix B.

Number of patients impacted

The number of patients impacted by the admission order set intervention (843) and by the discharge bundle intervention (818) was based on data from AHS administrative databases and measured from project implementation to March 31, 2019.

Impact of the intervention

COPD Standardized Admission Order Set: Cost savings were estimated by multiplying the change in hospital LOS (in days per patient) after the intervention by the cost per COPD hospital day and the number of patients impacted by the intervention. We used data from this initiative (Pendharkar et al. 2018) and multivariate median regression to compare LOS when using and not using the order set. The estimated change in hospital LOS when the order set was used was a reduction of 1.15 days per patient.

COPD Standardized Discharge Bundle: Atwood et al. (2019) compared patients in Alberta discharged using the COPD discharge bundle to those who were not and noted a 4% reduction in readmissions within 30 days of discharge when the discharge bundle was used. Cost savings were estimated by multiplying the reduction in hospital readmissions by the number of patients and the cost per readmission.

Assumptions, limitations and exclusions

Additional benefits (e.g., improvements in patient experience) have not been monetized, but are described below.

Results

Impact on health system resources	
Number of patients impacted	1,661
Gross savings per patient	$958.10
Gross savings for evaluation period	$1.59 million
Reported outcomes that support these savings:	
➲ Reduced LOS in hospital, fewer readmissions	Shorter hospital stays and fewer readmissions creates space for other patients. Portion of gross savings attributed to reduced LOS (COPD admission order set) was $1.17M and to fewer readmissions (COPD discharge bundle) was $0.43M. To date, this work has resulted in an estimated 1,322 hospital bed days avoided.
Additional benefits (not monetized within the ROI analysis)	
➲ Improved quality, efficiency and consistency of care	Standardized processes reduce duplication and assist staff in identifying and recording all activities related to COPD patient care. The discharge management plan ensures care providers review important information and resources with COPD patients prior to hospital discharge.
➲ Improved patient and family experience	Better coordination from hospital to community and primary care. Smoother transitions and integrated care throughout the patient journey.

E.13 Appropriate Use of Antipsychotics (AUA)

Seniors Health SCN and Addiction and Mental Health SCN

Overview

Antipsychotics are prescribed to people in long-term care (LTC) and designated supportive living (DSL) facilities to manage behavioral challenges in persons suffering from dementia. Prior to 2013, approximately 30% of residents in LTC facilities in Alberta were prescribed antipsychotics. Health Canada has published alerts regarding adverse side effects and safety risks of atypical antipsychotic use that negatively impact seniors' quality of life. Risks and side-effects of these medications include agitation, confusion, falls, insomnia and sedation, along with increased risk of infection, strokes and cardiac events.

In 2013, the Seniors Health and Addiction and Mental Health SCNs launched the AUA project, which aimed to reduce antipsychotic use in LTC facilities to less than 20% by March 2018. The project focused on dementia-friendly approaches to manage responsive behaviours. Care teams (including families, physicians and staff) consider the unique needs of each resident and work together to investigate and trial approaches to reduce responsive behaviours such as agitation and anxiety. The project involved:

1. Developing and implementing AUA Clinical Guidelines and a Toolkit for clinical teams to reduce unnecessary use of antipsychotics.
2. Staff education, discussions with family members, and development of resident- and client-specific care plans.
3. Monthly medication reviews and discussions involving all members of the health care team, including families.
4. Tracking antipsychotic use and related indicators.

Implementation

The project has been spread across Alberta to all LTC facilities and 179 DSL sites.

Jan 2013	Development of AUA Clinical Guidelines and Toolkit
2013–2014	Phased implementation beginning with 11 early adopter LTC sites
2014–2015	Provincial spread completed at LTC sites across Alberta. At the time, this included 170 facilities/14,500 beds.
2015–2016	Expanded to include 10 early adopter DSL sites
2016–2018	Spread to 179 DLS sites and continued to sustain the work in LTC sites
Feb 2017–present	Piloted this approach in 10 acute care sites as part of the Elder-Friendly Care initiative.

Evaluation

The impact of the AUA project on overall costs was assessed based on *the number of strokes (major or minor) prevented by the intervention and cost per event.*

System costs

The one-year cost to care for a person with moderate to severe stroke ($40,481) was retrieved from Zhang et al. (2019) using 2018 Alberta data. The cost to manage a minor stroke (transient ischaemic attack or TIA) ($5,858) was retrieved from the Alberta Health Interactive Health Data Application (www.ahw.gov.ab.ca/IHDA_Retrieval). Unit costs and data sources are listed in Appendix B.

Number of patients impacted

The number of LTC residents and DSL clients using antipsychotic medications was tracked at all sites and is reported within AHS administrative databases for the evaluation period (before and after project implementation to March 31, 2019). The total number of people impacted by the intervention (12,840) was estimated using published data and AHS administrative databases, as described below.

Impact of the intervention

Antipsychotic use: We used linear regression with quarterly data (three years for LTC sites and one year for DSL sites) before the intervention to estimate the trend in antipsychotic use over time. Using this information, we calculated the number of people with dementia expected to be treated with atypical antipsychotics if the intervention had not been in place. This was estimated for every quarter after the intervention, until March 31, 2019. The difference between the expected number (calculated by the linear regression) and the actual number (retrieved from AHS administrative databases after the intervention) was considered the impact of intervention.

Number of strokes: The number of strokes (or TIAs) was estimated based on the risk of stroke among atypical antipsychotic drug users. We used data reported by Banerjee (2009), which estimated that use of AUA is associated with an additional 18 strokes or TIAs per 1,000 users every three months (compared to non-users), of which 50% were severe.

Assumptions, limitations and exclusions

This evaluation assumes that the impact of anti-psychotic medications on strokes would be similar in Alberta to that reported by Banerjee (2009). We assumed the cost of a severe stroke would be similar to the cost of a stroke, and the cost of a minor stroke would be equivalent to the cost of managing a patient with a TIA.

Costs of antipsychotic drugs were not included in the analysis as data were not available for all sites. As such, the estimated savings are likely underestimated.

Additional benefits (e.g., improvements quality of life) have not been monetized, but are described below.

Results

Impact on health system resources and HSU	
Number of patients impacted	12,840
Gross savings per patient	$417.05
Gross savings for evaluation period	$5.35 million
Reported outcomes that support these savings:	
➲ Reduced number of strokes (major or minor) owing to reduced antipsychotic use at LTC facilities	Alberta now has the lowest rate of antipsychotic use in Canada. Just 17.1% of Alberta's LTC residents (without a chronic mental health condition) are using antipsychotic medications, compared to the national average (21.2%; 2017/18). To date, the AUA project has resulted in an estimated 3,770 hospital bed days avoided.

Additional benefits (not monetized within the ROI analysis)	
➲ Reduced cost of antipsychotic medications	Costs of antipsychotic drugs were not included in the analysis as data were not available for all sites. As such, the estimated savings are likely underestimated.
➲ Improved resident and family experience, quality of life	Families report that their loved ones are more alert, independent, communicative and happy. Care teams report residents are calmer, more active and easier to care for. Physicians and staff have resources to engage families and develop resident-specific care plan and alternative strategies for managing responsive behavior
➲ Recognition as a leader in health improvement	The AUA Project team has been recognized for this work and received the 2014 AHS President's Award for Excellence in Quality Improvement.

E.14 National Surgery Quality Improvement Program

Surgery SCN

Overview

AHS is participating in The National Surgical Quality Improvement Program (NSQIP), which uses clinical data to understand and improve performance. The program is operated through the American College of Surgeons (ACS) and helps sites measure, assess and improve surgical care.

NSQIP data supports decision making and quality improvement at a local level. Site quality and safety teams collect clinical data (e.g., pre-existing risk factors, complications and post-operative outcomes) and use this information to identify opportunities for improvement. Surgical teams and medical, nursing, and administrative partners at each site, prioritize and design improvement plans that will lead to better outcomes for patients, and implement the practice changes required to reduce surgical complications and improve the quality and safety of care. Teams come together annually to share their experiences and optimize the benefits of this program across all sites.

Implementation

NSQIP has been implemented at the 16 highest volume surgical centres in Alberta.

2015–2016	NSQIP piloted at five major surgical sites across the province, one in each AHS Zone (Grande Prairie, Edmonton, Red Deer, Calgary, Lethbridge). Pilot sites have produced four calendar years of surgical data that supports decision making for surgical quality improvement determined by each site
2018	The AHS Board and Executive Leadership Team approved NSQIP expansion to 11 additional sites (16 total) in the North Zone [Fort McMurray], South Zone [Medicine Hat], Edmonton and Calgary Zones).
2018–present	Expansion sites continue to build their databases and establish infrastructure to support improvement work based on site-specific data and priorities. NSQIP data is reported quarterly and annually at site, zone and provincial levels. Data from all sites is accessible through AHS Analytics for quality improvement and will be used to support the development of a comprehensive provincial surgical quality improvement program.

Evaluation

Costs or savings were estimated based on *the number of adverse events prevented by the NSQIP intervention* and the *cost per event*. We included the five pilot sites in the ROI analysis: Queen Elizabeth II Hospital in Grande Prairie, University of Alberta Hospital in Edmonton, Red Deer Regional Hospital in Red Deer, Rockyview General Hospital in Calgary, and Chinook Regional Hospital in Lethbridge. Because different sites had different interventions, they also focused on reducing different adverse events. The adverse events by site include:

- orthopedic surgical site infections (Grande Prairie)
- colorectal and urology surgical site infections (Edmonton)
- orthopedic blood transfusions and gynecology and urology urinary track infections (Red Deer)
- cystectomy LOS and readmissions (Calgary)
- orthopedic surgical site infections (Lethbridge)

We estimated costs or savings separately for each site and then summed them to estimate the total costs or savings of NSQIP.

System costs

System costs for adverse events were estimated using provincial costing, data from AHS Finance, Business Advisory Services (BAS) and Data Integration, Measurement and Reporting (DIMR) Services, and reported by Thanh et al. (2019). Program costs (e.g., NSQIP membership, physician stipend and nurse coordinator) were included in the analysis.

Number of patients impacted

The total number of patients (39,854) impacted by the intervention from implementation to March 31, 2019 was retrieved from AHS administrative databases for four sites and proportionately extrapolated from Thanh et al. (2019) for one site (Chinook Regional Hospital).

Impact of the intervention

For each site, costs or savings of NSQIP were estimated by multiplying the costs or savings per patient with the number of patients impacted by the intervention from its start date to March 31, 2019. We used the costs or savings per patient estimated by Thanh et al. (2019) and assumed that these impacts continued until March 31, 2019.

Assumptions, limitations and exclusions

Costs and savings of NSQIP implementation were not calculated for all 16 participating sites (only the 5 pilot sites).

Additional benefits (e.g., improvements in health outcomes, and the experience and satisfaction for patients, families and staff) reported by family members and care teams have not been monetized, but are described below.

Results

Impact on health system resources and HSU	
Number of patients impacted	39,854
Gross savings per patient	$495.30
Gross savings for evaluation period	$19.74 million
Reported outcomes that support these savings:	
➲ Reduction in the number of adverse events specified for each site	Since NSQIP implementation, hundreds of surgical site infections and urinary tract infections have been prevented among patients at the five pilot sites, which are among Alberta's highest-volume surgical centres (Thanh et al. 2019). Reductions in blood transfusions, readmissions and hospital LOS were also observed. To date, NSQIP implementation in Alberta has resulted in an estimated 16,426 hospital bed days avoided.
Additional benefits (not monetized within the ROI analysis)	
➲ Improved quality, safety and consistency of care and increased capacity	Participation in proven surgical quality improvement programs provides clinical data necessary to understand and improve performance and support shared learning across sites and enhanced system efficiency. As Thanh et al. (2019) reports, "These cost-savings would result in increased capacity gained at the sites through a decrease in length of stay." The program promotes a cohesive provincial approach and includes an audit and feedback mechanism so participating sites can evaluate and improve performance.

E.15 Enhanced Recovery After Surgery (ERAS)

Surgery SCN

Overview

Nearly 300,000 surgeries are performed each year across Alberta. With more than 55 surgical sites, there can be wide variations in surgical practices and outcomes. Recognizing the opportunity to standardize practices and improve surgical care, and the benefits this would bring to patients and care providers, several SCNs took action to bring Enhanced Recovery after Surgery (ERAS) care to Alberta.

ERAS care is based on international guidelines and provides a consistent way of managing patient care before, during and after surgery. Each guideline specifies protocols for patient care and draws on best practices and evidence from around the world, and their implementation has been shown in randomized trials to help patients stay strong physically and mentally, recover faster, spend less time in hospital, and experience fewer complications. ERAS also makes patients part of the team by involving them in preparation for their surgery and post-operative recovery, creating a more positive patient experience.

In 2013, four SCNs partnered with clinical care teams, operational leaders and patients to plan how to adapt and implement ERAS guidelines at local hospitals. Two components of this project were evaluated for this report: (1) ERAS for colorectal surgeries, and (2) ERAS for gynecological oncology surgeries.

Implementation

Implementing ERAS guidelines in Alberta began in 2013 with a phased approach. ERAS care has been expanding in Alberta since its launch in 2013. It has been implemented at 9 surgical sites in urban centers and has expanded beyond colorectal surgeries. Over the next three years, the goal is to roll out ERAS care across most surgeries and hospitals in Alberta.

2013	ERAS guidelines piloted at 6 sites (in Calgary and Edmonton) for patients undergoing elective colorectal surgeries.
2016	ERAS Alberta expanded the program to 9 surgical sites (in Lethbridge, Calgary, Edmonton and Red Deer) and to other elective surgeries, including gynecological oncology, pancreas, cystectomy, liver, breast reconstruction and major head/neck.
2019	ERAS Alberta continues to build out a full-scale implementation. Further details will be included in 2020 update on ROI.

Evaluation

The impact of ERAS on overall costs was assessed based on *hospital length of stay (LOS)* for patients undergoing colorectal surgery or gynecological oncology surgery.

System costs

System costs for hospital stays were estimated using provincial costing and data from AHS Finance, Business Advisory Services (BAS) and Data Integration, Measurement and Reporting (DIMR) Services as reported in Thanh et al. (2016). Unit costs and data sources are listed in Appendix B.

Number of patients impacted

Colorectal surgeries: The number of patients (8,072) impacted by the intervention was based on AHS administrative databases and measured from project implementation (September 1, 2013) to March 31, 2019.

Gynecological oncology surgeries: The number of patients (1,841) was based on AHS administrative databases and measured from project implementation (November 1, 2016) to March 31, 2019.

Impact of the intervention

Colorectal surgeries: Impact was estimated by multiplying the costs or savings per patient with the number of patients impacted by the intervention. The savings per patient ($2,406) were retrieved from Thanh et al. (2016), by dividing the total savings ($3,116,340) by the number of patients (1,295) in the evaluation period.

Gynecological oncology surgeries: Impact was estimated by multiplying the costs or savings per patient with the number of patients impacted by the intervention. The savings per patient ($1,862) were retrieved from Bisch et al. (2018), by dividing the total savings ($683,354) by the number of patients (367) in the evaluation period.

Assumptions, limitations and exclusions

All participating sites were included in the analysis; however, costs and savings of ERAS implementation were evaluated only for colorectal and gynecological oncology surgery. Other types of elective surgeries in which ERAS protocols are used were not included in this evaluation.

Additional benefits (e.g., improvements in health outcomes) have not been monetized, but are described below.

Results

Impact on health system resources and HSU	
Number of patients impacted	9,913
Gross savings per patient	$2,305.33
Gross savings for evaluation period	$22.85 million
Reported outcomes that support these savings:	
➲ Reduced LOS in hospital	Results from the first six sites showed that patients receiving ERAS care were able to return home an average of 1.54 days sooner, with fewer complications and no increase in readmissions. Portion of gross savings attributed to colorectal patients was $19.4M and to gynecological oncology was $3.4M. To date, ERAS care for colorectal and gynecological oncology surgeries has resulted in an estimated 15,702 hospital bed days avoided at surgical sites across Alberta.
Additional benefits (not monetized within the ROI analysis)	
➲ Improved quality of care and value	Since implementing ERAS care in 2013, there have been significant clinical improvements and a net reduction in system cost per surgical case
➲ Improved outcomes, fewer complications	Following surgery, ERAS patients experienced fewer post-surgical complications (e.g., lung and heart problems), earlier mobilization, and improved nutrition status. For gynecological oncology surgeries, the proportion of patients who developed at least one post-surgical complication decreased by 18.5% post-ERAS implementation (.Bisch et al. 2018)
➲ Improved patient experience and satisfaction	ERAS involves patients and families in their own care and teaches them ways to stay strong physically and mentally and support their own recovery. Patients report a better surgical experience and greater satisfaction.

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