

Reducing costs in hospitals

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Executive Summary

Background

Rising demands for healthcare due to complex care needs, economic and demographic changes applies constant financial pressure on health services. To address these demands, hospitals continue to seek innovative strategies to reduce costs without compromising the safe delivery of high value care to their patients. The Centre for Clinical Effectiveness has conducted a review of literature describing these strategies and the cost savings they report.

Objective

To review the literature about successful strategies used by hospitals to reduce costs while maintaining patient safety and high value care delivery.

Search Strategy

A search of grey and peer reviewed literature “cost saving in hospitals” was conducted in Google (17 April 2019) and Google Scholar (1 May 2019). The searches were sorted according to relevance.

Results

A total of 1020 articles were screened by one reviewer (GY) according to the Inclusion/Exclusion criteria in Table 1. Articles that did not report on primary outcomes of interest were excluded. A total of eight articles were selected for their inclusion in the review.

Conclusions

This report assembles lessons about transformation efforts they have been undertaken to address the pressures from rising health care costs while providing high quality care. Many examples suggest potential cost-saving strategies and, describe projected benefits or estimate potential cost savings. There is very limited literature reporting the actual impact of strategies on hospital costs.

This review highlights a paper¹ written by CEOs of health services that include Cleveland Clinic, Cincinnati Children’s Hospital, Kaiser Permanente, Intermountain Institute for Care Delivery Research, Virginia Mason Health System and Department of Veterans Affairs. It outlines a “CEO Checklist for High-Value Health Care” describing principles, to enable current work-plan development, as well as strategies that sustain and reinforce system-wide transformation necessary for continuous improvement in the face of rapidly increasing pressures, demands, and market changes. The four principles are outlined in Figure 1 and include:

1. Foundational elements,
2. Infrastructure fundamentals,
3. Care delivery priorities,
4. Reliability and feedback

The principles from the CEO Checklist for High-Value Health Care^[1] have been used to categorise case studies (reported within the CEO report ^[1]) as well as other evidence identified by this review ^[2-8]. This includes individual case examples and studies that report on the implementation of different strategies that can be described as developing a culture of continuous improvement achieved through quality improvement methodology; implementing evidence-based care, information technology best practices, and the sustainable use of resources; integrating and coordinating care through a team approach; as well as embedding safeguards, anti-microbial stewardship and being transparent within the health service. Figure 1 illustrates the principles and categories of strategies.

In total there were 19 individual case examples and studies ^[1-9]. With the exception of one study, based in Adelaide, all the other studies were based in the United States. The categorisation of individual cases and studies to principles are listed in the full report. Details about each strategy implemented and associated cost savings are also outlined. Some examples are also included in Figure 1.

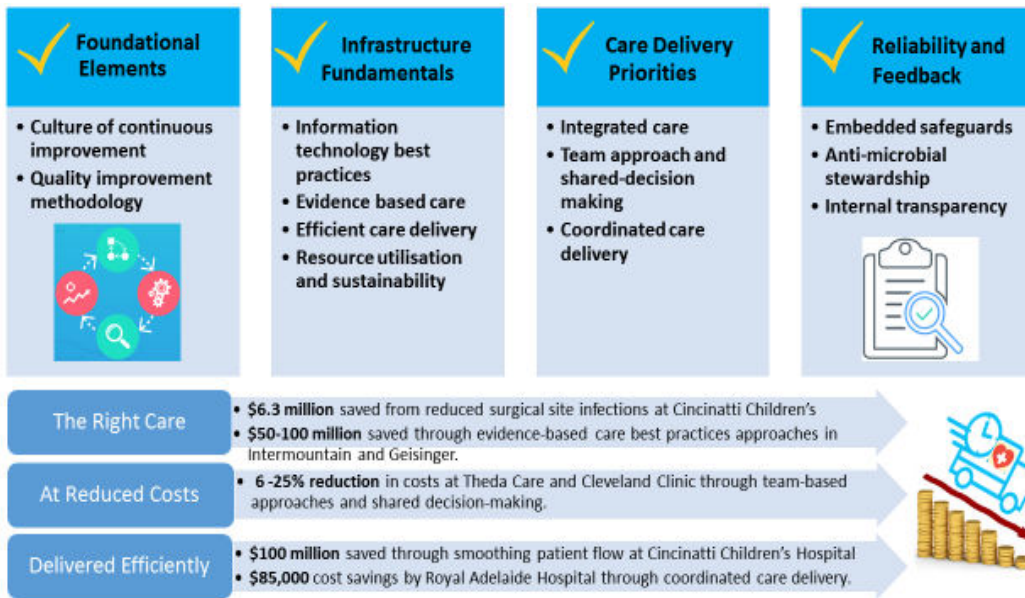


Figure 1. CEO Checklist for High-Value Health Care ^[1] principles and categories of strategies.

Background

Rising demands for healthcare due to complex care needs, economic and demographic changes applies constant financial pressure on health services. To address these demands, hospitals continue to seek innovative strategies to reduce costs without compromising the safe delivery of high value care to their patients. The Centre for Clinical Effectiveness has conducted a review of literature describing these strategies and the cost savings they report.

Objectives

To review the literature around successful strategies on how hospitals have reduced costs while maintaining patient safety and high value care delivery.

Search strategy

Inclusion/Exclusion Criteria

Table 1. Inclusion/Exclusion criteria

Population	Include: All
Interventions	Include: Cost saving or cost reduction strategies
Context	Include: Hospitals, community health Exclude: Primary care, healthcare systems, small services, outpatient clinics
Outcomes	Include: Primary outcomes: Cost savings, cost reduction Secondary outcomes: Related to quality of care, patient satisfaction, patient safety
Types of evidence	Include: All types; grey and peer reviewed literature Exclude: Blogs
Limits	Date: Not limited Language: Publications in English.

Search strategy

A search on “cost saving in hospitals” was conducted in Google (17 April 2019) and Google Scholar (1 May 2019). The searches were sorted according to relevance.

Study Selection

A total of 1020 articles were screened by one reviewer (GY) according to the Inclusion/Exclusion criteria in Table1. Articles that did not report on primary outcomes of interest were excluded.

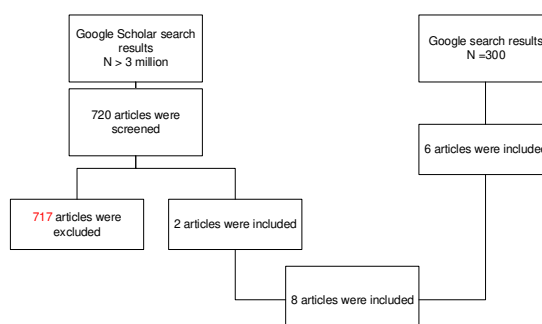
Results

Summary of Findings

This diagram indicates the flow of identified and included articles from the two internet sources searched.

As the number of hits achieved in Google Scholar reached over 3 million, only the first 720 (first 7 pages) articles were screened in order of highest relevance.

A total of eight articles were selected for their inclusion in the review.



Synthesis of Findings from Grey literature

“A CEO checklist for high-value health care” describes opportunities for hospital Chief Executives and Boards to improve the value of health care in their institutions according to four principles: Foundational elements, Infrastructure fundamentals, Care delivery priorities, Reliability and feedback [1]. The following section categorises case studies from seven other sources according to these four principles so that each principle is illustrated with at least one relevant case study that describes the strategies implemented, setting, and the cost savings involved.

A total of 19 case studies were described under 12 sub-principles, in 12 different hospital settings in United States and Australia. Only one case study identified was based in Australia [7].

✓ Principle 1: Foundational elements

1. A culture of continuous improvement [1] saved USD \$158 million

Setting 1: Denver Health; Colorado’s primary safety-net institution serving almost one-third of Denver’s residents.

Denver Health adopted Lean as the philosophy and toolset to use in redesigning care. Lean is built on respect for people and continuous improvement, and focuses on reducing waste from the customer perspective.

The two-pronged approach was used to implement Lean:

- Organisational leaders (Black Belts) trained in Lean used Lean in their day-to-day work to identify and eliminate waste
- Week-long rapid-improvement events were derived from 16 areas of focus or “value streams.”

The areas of focus spanned the entire integrated system of care, from paramedics to obstetrics and from back-office functions to clinical care.

Their achievements:

- \$158 million in financial benefit since 2006
- 50% increased overall patient satisfaction ranking

2. Quality improvement methodology [2] saved > USD \$250,000

Setting 1: Children’s Hospital at Medical University of South Carolina (MUSC); a large academic medical center in Charleston.

Children’s Hospital at the Medical University of South Carolina needed an effective way to reduce costs. There now was a new expectation of all staff members and leaders to spend 80% of time on completing their necessary jobs, and the other 20% on finding ways to do them safer and more efficiently. This provided a catalyst to engaging hospital employees and medical staff in leading financial and improvement efforts (i.e., improving efficiencies, reducing waste, standardizing practices and reducing avoidable complications).

The MUSC used the following approaches to achieve their desired results:

1) Examining the past

The Chief Medical Officer assigned a committee (i.e., IMPROVE Committee) with representation from finance, quality, data analytics and strategic planning examined past strategies to understand why cost-cutting efforts were not successful. Through face-to-face interviews, five reasons were identified why past efforts had failed:

- Incomplete data and reporting
- Lack of a standard approach
- Minimal involvement from the medical staff
- Inadequate collaboration between patient care units and support areas
- Poor accountability to outcomes

2) Process into action

The process to reduce costs started with senior leadership. The Director of Business Operations worked with finance and data analytics departments to prioritise key financial performance measures for monthly review by the hospital leadership team. These measures included direct costs (broken out by labour and supplies), total overtime costs and full time equivalents, and total costs per discharge (adjusted for outpatient volume and case mix index). A work group then reviewed the list each month to identify gaps in performance, generate a list of projects and each was assigned to a process owner who was a hospital or medical staff leader.

Their achievements:

- Annual savings of more than \$250,000
- 19% reduction in overtime costs per pay period
- 17% reduction in costs per case
- 30% reduction in pharmaceutical costs per case
- 15% reduction in lab costs per case
- 11% reduction in length of stay

Each financial savings project was required to follow standard process improvement (PI) methodology – **IMPROVE**: **(I)**dentify, **(M)**easure, **(P)**roblem analysis, **(R)**emedy, **(O)**perationalise, **(V)**alidate and **(E)**valuate, and have a projected, validated financial benefit.

Although facilitators from the Performance Improvement (PI) department were available for support, it was the leader's responsibility to ensure the project progressed. Leaders (i.e., process owners) were required to report to senior leadership on a monthly basis in a formal, fact-driven format called value and accountability presentations, which ensured the clinical leaders at the department and program levels were engaged and motivated to demonstrate success.

Service lines were divided into three tiers based on their performance against a series of key performance indicators (KPI):

- Top tier reported their KPI electronically to the Chief Operating Officer.
- Middle tier reported quarterly in person to Chief Executive, Chief Operating, Chief Finance, and Chief Quality Officers, accountability director and strategic staff members.
- Bottom tier reported monthly to the working group to demonstrate improvements in KPI.

3) Closer look at quality

There were two types of performance improvement projects as part of the quality network.

- Large-scale, organisation-wide projects that senior management initiates.
 - Smaller-scale service projects that any unit, department or program can initiate.
- When teams launch projects, the Quality Operations Committee, which includes service line employees and senior leadership team members, approves project milestones. Teams are responsible for monitoring and reporting their progress to the IMPROVE Committee.

Project teams must use data; and the task of data gathering falls on the Measurement Committee. The Measurement Committee examined and prioritised hundreds of possible quality and safety metrics, to identify opportunities within the metrics. A formal IMPROVE project is launched using the above IMPROVE methodology (as mandated by the Chief Executive Officer for all projects).

4) Enlisting help

Although the medical centre has a central Performance Improvement (PI) department, all leaders learn to effectively run IMPROVE projects.

A Project Team consists of facilitators who are impartial, internal experts. Facilitators lead and guide teams toward ownership of project outcomes. They clearly communicate at the beginning of each project that the team members have the responsibility to accomplish the project task or action items, and the champion and process owners are accountable for these activities and the success of the project. It is important that the internal experts facilitate but do not take over projects for the teams.

The level of engagement from medical staff was unprecedented, and one of the keys to success when the medical center introduced the new process for quality and safety.

To ensure that leaders are armed with the tools they need, the Performance Improvement Department provides a one-day class that prepares them to run a project from beginning to end. The department also provides access to an IMPROVE facilitator who consults with teams and ensures projects follow the model. PI projects must consist of an inter-professional team, so all stakeholders are part of providing the solution to whatever problem a given project is tackling. Finally, the organisation drives accountability by adding specific quality goals to the annual performance evaluations of all appropriate staff and leaders, including medical directors.

5) Patience

Timescale: It took six months for improvement to be observed; and two years to achieve targeted cost reductions.

It is critical for organisations to establish goals, ensure employees fully understand what is expected of them, and hold them accountable for the results. Using the IMPROVE process, clinical and non-clinical staff members have demonstrated it's possible to improve quality and, at the same time, drive down costs.

While that is good news to regulators and payers, the real beneficiaries are the patients and families that the medical center and its children's hospital serve.

✓ Principle 2: Infrastructure fundamentals

1. Information Technology best practices ^[1] saved USD \$10,000 – \$1.7 million

Setting 1: Cleveland Clinic; Large, nonprofit, multi-specialty academic medical center with almost 1,400 beds on Cleveland Clinic main campus and 5,895 beds system-wide. ^[6] (United States)

The Cleveland Clinic reduced overuse through Computerised Physician Order Entry. The Clinic reviewed all computerised order sets and monitored the frequency of laboratory tests that show no significant variation during at least a 24-hour period of time. All standard order sets were updated, and after background collection of data, Cleveland Clinic initiated a same-day block or “hard stop” of eight laboratory tests. When duplicate orders were placed within the electronic medical record, providers were notified of the current day’s result or that the test was pending. A provider override system was created via a call to the clinical pathology group. The “hard stop” preventing ordering was expanded to 100 and later to 1,241 individual tests.

A second tier of screening was instituted for genetic testing. After collaboration with the relevant clinical providers, a series of molecular tests for 30 conditions were restricted to providers with appropriate training to independently order the tests. Others were required to consult a genetic counselor prior to ordering tests.

Setting 2: Geisinger; regional health care provider to central, south-central and northeastern Pennsylvania and southern New Jersey, servicing over 3 million patients in 45 counties (United States)

Geisinger implemented a series of health IT initiatives to improve quality and enhance efficiency, such as electronic health records; a health information exchange; ePrescribing modules; a data warehouse; and comprehensive document management

Their achievements:

- \$10,000 in monthly savings for laboratory tests (excluding blood gas)
- \$117,000 in first-month savings for molecular testing

Their achievements:

- \$1.7 million from reduced chart pulls in 5 years; >\$600,000 from reduced printing and faxing
- > \$500,000 annually from reduced nursing staff time through ePrescribing

2. Evidence based care ^[1,3] saved USD \$50 – \$100 million

Setting 1: Intermountain: Not-for-profit system of 23 hospitals, 170 clinics, a Medical Group, with 2,300 employees (United States)

Active Care Management is an evidence-based approach to labor and delivery, which involves:

- An evidence-based best practice guideline, blended into clinical workflows;
- An aligned data system, also embedded into clinical workflows, that tracks guideline variance in parallel with intermediate and final clinical, cost, and service outcomes;
- Full integration into an electronic medical record system
- A full set of educational materials for patients, family, and professional staff

Their achievements:

- Cost saving of \$50 million
- \$10 million annual reduction in maternal and newborn variable costs
- 26% point drop in inappropriate elective inductions of labor since 2001

Setting 2: Geisinger; regional health care provider to central, south-central and northeastern Pennsylvania and southern New Jersey, servicing over 3 million patients in 45 counties (United States)

Cardiac surgeons identified evidence- or consensus-based best practices from nationally published guidelines for patients undergoing elective coronary artery bypass.

A variety of standardised order sets, decision-support tools, and reminders were created in the electronic health records, with tracking and reporting of adherence to the provision of each element of care.

Their achievements:

- Reduced costs by >\$1,900 per case
- 67% reduction in operative mortality
- 1.3-day decrease in length of stay

3. Efficient care delivery ^[1,3] saved USD \$100 million

Setting 1: Cincinnati Children's Hospital Medical Center; a 700-bed pediatric hospital located in Cincinnati, Ohio that is ranked second among all Honor Roll hospitals in 2018-19 U.S. News & World Report survey of best children's hospitals (United States)

With an objective of smoothing patient flow, the Cincinnati Children's Hospital Medical Center implemented a series of operations-management interventions, with the goal of reducing daily artificial variation to make bed occupancy more predictable.

To do this, staff analysed patient-flow dynamics, evaluating surgical providers' predicted need for intensive care and predicted length of stay (LOS). When a procedure was scheduled, surgical providers made initial LOS estimates on the basis of personal experience, the complexity of the case, patient co-morbidities, best-practice plans, and historical data.

The electronic surgical scheduling system was revised so that the operative case and an ICU bed (if needed postoperatively) were scheduled (reserved) at the same time. The surgeon estimated a projected LOS when the case was initially scheduled. Reserved beds were continuously monitored, and the computerised scheduling system restricted operative-case scheduling if a bed was needed and the elective case limit for that day had been reached. An admission control model was used to limit the maximum allowable elective surgical cases requiring ICU access per day. A simulation model was developed for the ICU to predict bed occupancy for all medical and surgical (elective and emergent) patients.

Their achievements:

- \$100 million in capital costs avoided
- Decreased variability of new elective surgical admissions
- Decreased diversion of patients to other units and delay/cancellations

4. Resource utilisation and sustainability ^[1,4,5] saved USD \$3 – \$200 million

Setting 1: Gundersen Health Systems: a nonprofit hospital network operating in 19 counties across three Midwest states (United States) ^[4]

By October 2014, Gundersen Health Systems, became the first U.S. health system to attain energy independence.

The Envision program, which aims for leadership (and monetary returns) through the four pillars of energy conservation, waste management, recycling and sustainable design — all while reducing the cost of care.

The philosophy behind Envision, which commenced in 2008, is driven by the idea that it's possible to make a positive environmental impact while reducing costs for patients. As solar was not a strong financial option in Wisconsin, a mix of landfill gas, biomass, dairy digesters and wind turbines was implemented.

A biomass boiler turns wood from the local lumber industry into steam energy, the health system's major source of power. A 300-ton geothermal heat pump, supported by hundreds of wells dug beneath parking lots, leverage Earth's natural temperature for year-round heating and cooling. Dairy and manure digesters churn farm waste into 20 million kW hours of renewable power while preventing runoff-enriched algae blooms in waterways.

Additionally, Gundersen collaborates with two wind farms, each generating enough electricity to power 1,200 homes. The hospital system is paid for the power, offsetting its energy cost, while it sells the electricity to homes and businesses. It partnered with the La Crosse County waste department to produce gas from landfill trash. Solar panels dot parking ramps and a solar water heater powers a child care office and a renal dialysis center.

An ounce of prevention diverts a pound of cure; Gundersen's 45% recycling and reuse rate keeps 740 tons of furniture, food and X-ray film out of landfills. Sustainability improvements save Gundersen \$3 million annually, according to the health system's data.

Their achievements:

- ~\$3 million saved annually
- \$265,000 reclaimed annually from retrofitting light fixtures
- >\$4,300 saved by replacing exhaust fans, which had been running 24/7
- \$70,000 annual savings from upgrading old water chillers to energy-efficient models
- \$165,000 annual savings from automatic computer shut-off routines in the evenings

Setting 2: Cleveland Clinic; Large, nonprofit, multi-specialty academic medical center with almost 1,400 beds on Cleveland Clinic main campus and 5,895 beds system-wide. (United States) ^[5]

In the United States, hospitals are the second greatest commercial energy user behind commercial food services, according to advocacy group Practice Greenhealth, emitting roughly 8% of the country's greenhouse gas emissions. They also produce more than 4.67 million tons of waste every year and use 7% of the country's commercial water supply.

Cleveland Clinic has done a lot over the past 10 years to become more sustainable. The Clinic has committed to a 20% reduction in energy usage per square foot for their buildings

Their achievements:

- \$3-6 million in energy costs saved
- Savings of \$250,000 and 6,000 trees

and has achieved 12% so far, saving \$6 million a year in energy costs. Their LED retrofit lighting project, which they tout as the biggest such project in healthcare, hinges on locally manufactured LED bulbs, which pumps money back into the community. As the lighting throughout the system converts, they will reduce lighting costs by \$3 million a year just by switching lightbulbs.

A “Green the OR Committee” was started to cut back on operating room waste. Just making sure air conditioning was not being used when the operating rooms were empty saved \$2 million. Single use devices could be reprocessed, resterilised and reused. Through a vendor programme, another \$2.5 million was saved annually.

In 2013, Cleveland made their printer/copier/scanner contract a zero waste contract. They recycled packaging and made double-sided printing the default setting.

Setting 3: Intermountain: Not-for-profit system of 23 hospitals, 170 clinics, a Medical Group, with 2,300 employees (United States)^[1]

In order to improve patient care and reduce costs, Intermountain Healthcare used an evidence-based approach to improve supply chain efficiency.

Intermountain’s supply chain organisation (SCO) works with Intermountain’s clinical programs to develop effective processes and strategies for supply chain management. Key to the SCO strategy is removing the supply burden from caregivers.

When Intermountain found that a significant number of central line-associated bloodstream infections (CLABSIs)—which impact patient recovery and are non-reimbursable—were occurring in the bone marrow transplant unit, a committee consisting of clinicians and supply chain experts was formed to research the practices and products associated with superior outcomes.

Their achievements:

- >\$200 million in savings in 5 years from supply chain improvements
- 2.3% reduction in the rate of infections (CLABSI)
- 32% reduction in cost per line

✓ Principle 3: Care delivery priorities

1. Integrated care delivery^[1,3] saved USD ~\$10 million

Setting 1: Partners HealthCare in Massachusetts—a nonprofit, integrated health system that includes community and specialty hospitals, community health centers, and other health-related entities (United States)

The Connected Cardiac Care Program, a self-management and telemonitoring program, helps patients with heart failure manage their health at home.

Its core components are care coordination, education, and development of self-management skills through the use of telemonitoring. Patients use equipment (a monitoring device and peripherals) in their home to submit weight, blood pressure, heart rate, and symptoms on a daily basis for 4 months.

Telemonitoring nurses monitor these vitals, respond to out-of-parameter alerts, and guide patients through structured biweekly heart failure education.

Their achievements:

- ~\$10 million in savings
- 51% reduction in hospital readmissions for patients with heart failure in 10 years
- 44% reduction in non-heart failure hospital readmissions

Setting 2: Geisinger; regional health care provider to central, south-central and northeastern Pennsylvania and southern New Jersey, servicing over 3 million patients in 45 counties (United States)

Geisinger leveraged two key components of its integrated health system structure to develop an advanced medical home model, named ProvenHealth Navigator® (PHN).

The PHN model has five core elements: (1) re-engineered patient-centered primary care, (2) integrated population management, (3) 360° care systems to form a medical neighborhood, (4) measurement of quality of care, and (5) a value-based reimbursement model.

Their achievements:

- 7.1% reduction in the total cost of care in 5 years
- 18.2% decrease in acute admissions
- 20% decrease in readmissions

2. Team based approaches and shared decision-making^[1,3] reduced costs by 6–25%

Setting 1: ThedaCare: Community Health system in Wisconsin (United States)

ThedaCare Collaborative Care Units, designed using Lean methods, organise care delivery around the patient’s experience.

This meant that an interdisciplinary care team coordinates with the patient to arrive at a mutually agreed-on care plan upon admission.

Their achievements:

- 25% reduction in hospital inpatient care costs, lengths-of stay, errors in patient care

The unified plan replaces the multiple, sometimes contradictory, plans of care previously maintained separately by physicians, nurses, and ancillary practitioners.

The nurse monitors the progression of care using evidenced-based guidelines available in the single care plan, which exists in the electronic health record. When they detect a barrier to the progression, it is the nurse who contacts the team's physician with recommendations, not the other way around.

Setting 2: Cleveland Clinic; Large, nonprofit, multi-specialty academic medical center with almost 1,400 beds on Cleveland Clinic main campus and 5,895 beds system-wide.^[6] (United States)

The improved Lung Transplant Care program involves daily huddles involving patients and caregivers, which helps keep caregivers, patients, and their families informed about each patient's prognosis and recovery and allows for the development of a cohesive care plan.

Attending physicians were scripted to take a threefold approach with patients:

- (1) introduction of the attending, in which the attending states that he/she will be responsible for the patient's care;
- (2) if another attending is assuming care, the current attending announces the change, including the incoming attending's name and states that the incoming attending will review the case with the current attending. The incoming attending then introduces himself/herself to the patient and reviews the discussion with the transferring physician;
- (3) on the day of discharge, the attending meets with the patient and family to review the course of the hospitalisation, home-going medications, follow-up appointment(s), and who to contact with problems and questions.

Follow-up data was obtained after 12 months and compared to pre-protocol implementation

- 6% reduction in costs of care
- 19% decrease (1.54 days) in ICU length of stay
- 7% decrease (1.34 days) in total length of stay
- 3% improvement in 30-day survival

3. Coordinated care delivery^[7] saved AUD \$17,050 – \$85,750

Setting 1: Royal Adelaide Hospital; a single tertiary-level metropolitan Australian hospital with 650 beds, which services a referral population of 600 000 people locally, with state-based specialty services serving an additional 300 000–400 000 people.

In keeping with recent trends, patients with hepatocellular cancer have had their care managed by a dedicated Nurse Coordinator.

Key roles of the Nurse Coordinator include:

The organisation of a fortnightly multidisciplinary team meeting (MDM); gathering pertinent clinical data, including imaging, pathology and procedural results; establishing clear lines of communication between specialists, primary care providers and the patient; patient education and hospital avoidance. This role represents a key recommendation of the South Australian Hepatocellular Cancer Care Pathway (2013) and has been essential in facilitating the best outcomes for this growing cohort of patients.

The independent initiation of follow-up investigations and interventions spared many surplus outpatient encounters; and prompt communication with patients and primary care practitioners helped to facilitate timely community-based investigations as necessary, eliminating unnecessary travel costs and loss of valuable workplace productivity.

- Minimum annual cost saving of \$85 750
- Net annual saving of AUD \$17 050

✓ Principle 4: Reliability and feedback

1. Embedded safeguards^[1] saved USD \$6.3 – \$17.5 million

Setting 1: Cincinnati Children's Hospital Medical Center; a 700-bed pediatric hospital located in Cincinnati, Ohio that is ranked second among all Honor Roll hospitals in 2018-19 U.S. News & World Report survey of best children's hospitals (United States)

To reduce the incidence of surgical site infections (SSIs), Cincinnati Children's implemented a bundle of interventions, each designed for reliability and error reduction.

Each surgical division developed a list of procedures for which antibiotic prophylaxis was required. To ensure timely and appropriate administration of prophylactic antibiotics, a

Their achievements:

- Average savings of \$27,000 per case
- \$6.3 million savings in 6 years
- ~233 surgical site infections

pediatric-specific list of appropriate antibiotics was developed. Pediatric dosing time frames, limits, and parameters for re-dosing were also established.

prevented in 6 years

A computerised forced-function was developed to attach required antibiotics to all procedures within the division specific list of evidence-based need for antibiotic prophylaxis.

A new file was added to the computer screen used by surgical schedulers to identify procedures for which antibiotics are required. This reminder was also printed on the operating room schedule for nurses, surgeons, and anesthesiologists to see.

For same-day surgery patients, the complete preoperative antibiotic orders were due before 10:00 a.m. the day before surgery, and an “identify and mitigate” process was established to identify potential failures. On the day of surgery, a medication nurse was required to confirm the antibiotic order and the accuracy of the dose, and to put an orange “antibiotic required” bracelet on the child as a reminder to the anesthesiologist.

Daily data concerning potential failures at any step critical for success were collected, and team leaders discussed any failures the next day with the critical providers. Additionally, a bundle compliance-monitoring form, designed to be completed by nurses, helped to build quality improvement into daily work.

Setting 2: Brigham and Women’s Hospital (BWH), a member of the Partners HealthCare System

Their achievements:

To reduce serious medication errors, Brigham and Women’s Hospital (BWH), a member of the Partners HealthCare System implemented pharmacy barcoding, in which pharmacists barcode-scan all medications dispensed from the pharmacy to ensure that the medications match physicians’ orders (which are entered electronically via computerised physician order entry [CPOE]).

- \$3.3 million in 5-year savings
- Annual savings of \$2.2 million from decreased adverse drug events
- 31% reduction in serious medication-administration errors

In addition, BWH implemented electronic medication-administration records (EMAR)/barcoding at the bedside, in which nurses scan medications prior to administration to patients, and are alerted about possible errors.

2. Antimicrobial stewardship ^[8] saved USD \$20,000

Setting 1: The Methodist; Hospital in Houston, Texas, a 1000-bed quaternary care academic hospital

Their achievements:

The Methodist implemented an evidence-based intervention that integrated matrix-assisted laser desorption and ionisation time-of-flight mass spectrometry (MALDI-TOF MS), rapid antimicrobial susceptibility testing, and near–real-time antimicrobial stewardship practices.

The goal of integrating rapid diagnostic microbiology laboratory techniques with antimicrobial stewardship practices was to improve outcomes among hospitalised patients with gram-negative blood stream infections.

If a gram-negative isolate was identified, the specimen was analyzed by the MALDI-TOF MS and simultaneously set up for antimicrobial susceptibility testing by the BD Phoenix system.

Positive blood culture specimens were inoculated on appropriate agar media for identification by conventional bacteriologic methods, if necessary. Species identification based on the BD Phoenix result was considered to be the reference standard. Microbiology laboratory personnel called the infectious diseases pharmacist with each result obtained for every hospitalised patient, 24 hours a day and 7 days a week. The on-call infectious diseases pharmacist had remote access privileges to patients’ electronic medical records.

After review, and when necessary, the infectious diseases pharmacist would contact the treating physician to discuss the results and formulate the most effective, targeted antimicrobial therapy. The pharmacist recommended de-escalation to targeted therapy when the final bacterial identification and/or susceptibility test results were available.

Recommendations related to dosing/route modifications or to escalate therapy were made when clinically indicated after review of the medical record. The MALDI-TOF MS analysis was performed 3-4 times daily.

- \$19,547 reduction in mean hospital costs
- Annual projected cost savings of ~\$18 million

3. Internal transparency ^[1] saved USD \$5,000 – \$30,000

Setting 1: Cleveland Clinic; Large, nonprofit, multi-specialty academic medical center with almost 1,400 beds on Cleveland Clinic main campus and 5,895 beds system-wide. ^[6] (United States)

Internal, non-blinded performance transparency at Cleveland Clinic

To engage providers in quality improvement and waste reduction, Cleveland Clinic implemented web-based business intelligence tools to collect and display provider performance data for a wide variety of metrics.

By giving providers transparent access to metrics that identify variations in practice, utilisation rates, and performance against internal and external benchmarks, Cleveland Clinic saw dramatic reductions in waste, improved quality, and a sustained change in culture, as practitioners take pride when they do well and foster the desire to change when they recognise the need to improve.

Their achievements:

- >40% reduction in ICU central line-associated bloodstream infections
- Cost avoidance of \$30,000 for each central-line infection and \$5,000 per case of urinary tract infection

Discussion and limitations

Limited evidence of actual cost-savings

While there were many examples suggesting 'potential' cost-saving strategies, estimating 'projected' or 'potential' benefits or cost savings, limited literature report on the impact of strategies being translated to actual cost savings to hospitals. In the discussion paper identified ^[1], four touchstone principles, illustrated with case examples are described: Foundational elements, Infrastructure fundamentals, Care delivery priorities, and Reliability and feedback. These principles include organisation governance priorities, continuous improvement, resource sustainability, information technology best practices, care that is evidence-based coordinated and integrated, shared decision making, embedded safeguards and internal transparency. This paper presents good examples of successful strategies implemented translating to actual hospital cost-savings.

Quality of evidence

It is important to note that four articles expressed views of the authors ^[1,2,4,5], while only three articles were peer-reviewed ^[3,7,8]. Furthermore, the discussion paper to which the principles were described ^[1] are not necessarily representative of the authors' organisations nor of the Institute of Medicine, and the paper had not been subjected to the review procedures of the Institute of Medicine or the National Research Council. Nevertheless, the paper presents examples of successful strategies implemented in hospitals which resulted in cost-savings. Using four principles, the authors describe basic opportunities for hospitals Chief Executives and Boards to improve the value of health care in their institutions. They believe that through communication and collaboration with colleagues and others, better outcomes at lower costs can be achieved through care transformation initiatives that yield improved results, more satisfied patients, and cultures of continuous learning.

Lack of uniform reporting of cost-savings

There was no uniform reporting of cost savings; cost savings were listed as cost reductions, cost savings or cost avoidance reported per case, annually, or accumulative (ranging from one to six years). Furthermore, one is unable to determine how these costings were derived in the articles. Nevertheless individual hospitals contacts are listed for further correspondence. Accurate costing is important as it allows the impact of process improvements to be readily calculated, validated, and compared. This proves to be challenging because of the complexity of health care delivery itself ^[9].

Transferability of impact to Australia

Lastly, with the exception of one case example based in Adelaide, Australia, all case examples were based in the United States. This limits the transferability of the perceived cost-savings impact that the strategies (implemented in the US) may be able to achieve in Australia.

Conclusion

Many examples suggest potential cost-saving strategies, describe projected benefits or estimate potential cost savings, however very limited literature report on the actual impact of strategies on hospital costs. The review highlights four touchstone principles (Foundational elements, Infrastructure fundamentals, Care delivery priorities, Reliability and feedback) further detailed according to 12 sub-principles and illustrated in 19 case examples. With the exception of one case study based in Adelaide, all the other case studies were based in the United States, which limit the perceived impact that may be transferable to the Australian context.

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