Novel quality improvement method to reduce cost while improving the quality of patient care: retrospective observational study

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ABSTRACT

Background Healthcare cost management strategies are limited in number and resource intensive. Budget constraints in the National Health Service Scotland (NHS Scotland) apply pressure on regional health boards to improve efficiency while preserving quality.

Methods We developed a technical method to assist health systems to reduce operating costs, called continuous value management (CVM). Derived from lean accounting and employing quality improvement (QI) methods, the approach allows for management to reduce or repurpose resources to improve efficiency. The primary outcome measure was the cost per patient admitted to the ward in British pounds (£).

Interventions The first step of CVM is developing a standard care model. Teams then track system performance weekly using a tool called the 'box score', and improve performance using QI methods with results displayed on a visual management board. A 29-bed inpatient respiratory ward in a mid-sized hospital in NHS Scotland pilot tested the method.

Results We included 5806 patients between October 2016 and May 2018. During the 18-month pilot, the ward realised a 21.8% reduction in cost per patient admitted to the ward (from an initial average level of £807.70 to £631.50 as a new average applying Shewhart control chart rules, p<0.0001), and agency nursing spend decreased by 30.8%. The ward realised a 28.9% increase in the number of patients admitted to the ward per week. Other quality measures (eg, staff satisfaction) were sustained or improved.

Conclusion CVM methods reduced the cost of care while improving quality. Most of the reduction came by way of reduced bank nursing spend. Work is under way to further test CVM and understand leadership behaviours supporting scale-up.

INTRODUCTION

Given increasing costs associated with healthcare delivery[1] and increasing challenges of healthcare affordability to individuals, employers and governments, new approaches to reducing cost and improving value remain essential. We developed continuous value management (CVM) in response to the need for approaches that can help health systems address cost pressures using well-understood quality improvement (QI) methods. Prior efforts to improve clinical quality and patient safety have focused on the role of front-line clinical teams to generate system-wide change.[2 3] Building on this experience, the CVM method engages clinical teams in cost reduction while continuing their work on improving quality.

The CVM method uses lean accounting tools to obtain a cost breakdown for the service unit on a near real-time basis. Lean accounting tools were created by lean consultants working in manufacturing to streamline financial management, moving away from a focus on budget cycles to a focus on actionable, nearly real-time financial data supplied to the front line.[4] Lean accounting tools are designed to complement lean management, an approach to eliminating waste and optimising workflows.[5–8] We applied a subset of lean accounting approaches—specifically, those aspects that capacitate front-line staff with actionable financial information.

Lean management has its origins in manufacturing, and especially in the Toyota Production System pioneered by Taiichi Ohno and Eiji Toyoda in the middle of the 20th century. Lean management prioritises standard work across roles and management work to support creation of value at the front line.

The pilot aimed to test the feasibility and effectiveness of CVM in a healthcare setting facing resource challenges. We hypothesised that CVM would reduce healthcare delivery costs while preserving or improving other elements of care

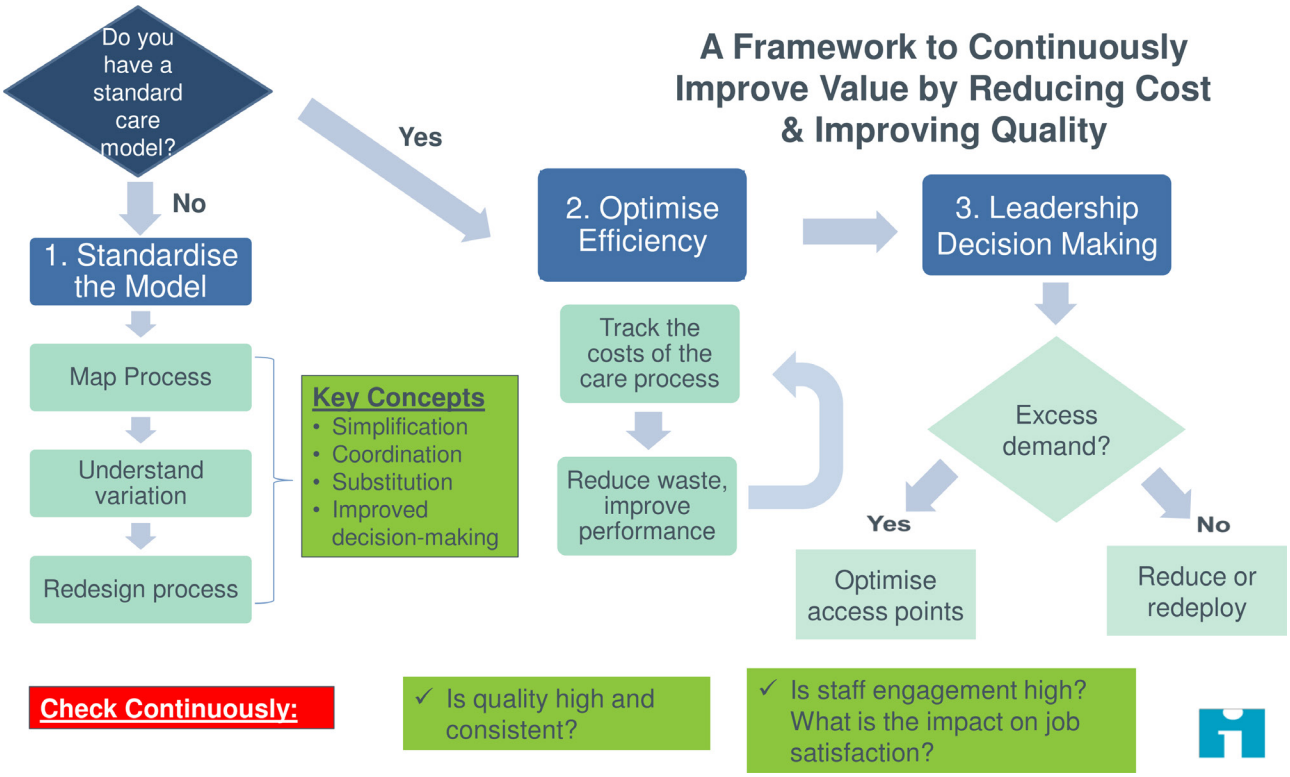

Figure 1 Continuous value management (CVM) framework. IHI, Institute for Healthcare Improvement; R&D, Research and Development.

quality. This paper describes the methods, implementation and findings from an 18-month pilot test of CVM in a National Health Service Scotland (NHS Scotland) regional hospital in Inverness, Scotland.

METHODS

This retrospective, non-randomised implementation study evaluated the impact of a novel management method (CVM) to improve value in a single hospital unit in NHS Scotland from October 2016 to May 2018. The study prospectively collected and analysed weekly time-series cost and quality data to assess the method's impact on the team's performance. As a QI project rather than a research study, this project did not solicit Institutional Research Board approvals.

The management method was implemented using QI techniques (Plan-Do-Study-Act (PDSA) cycles). The investigators assessed the impact of the methods on cost and quality over time, during the study period.

Setting

The CVM method was tested at Raigmore Hospital, a 452-bed district hospital in the Scottish Highlands[9] (part of a regional government-run health system, or 'board', called NHS Highland). At the time of site selection for CVM implementation, leadership considered the three teams that had just completed clinical process standardisation work (step 1 of the CVM method) via a 'rapid process improvement workshop'[10] in the prior 6 months. Leaders selected the inpatient respiratory ward for the pilot based on the team's interest in testing the methodology.

The front-line NHS team members involved in the pilot included the ward senior charge nurse, a physician lead, an accountant and other staff (eg, nurses, pharmacists, social work). The Board chief executive officer supported the pilot and designated the chief financial officer as the senior sponsor.

Intervention

A research team at the Institute for Healthcare Improvement (IHI) developed the CVM method using a 90-day innovation process.[11] Researchers reviewed existing value improvement methods such as time-driven activity-based costing,[3] data-driven clinical analytics systems[12] and microcosting[13] to develop a value management methodology and accompanying administrative tools that could be used by front-line managers easily and continuously.

The resulting CVM method (figure 1) includes three steps.

1. Teams develop a standard care model for a clinical service (eg, chronic obstructive pulmonary disease (COPD) pathway for a respiratory unit).
2. Teams improve the service using QI methods and continuous measurement of performance—quality and cost.
3. If the first two steps create efficiencies, health system executives work with managers to take advantage of the achieved efficiencies by accommodating latent demand or removing slack capacity from the system (eg,

Ward 7a Value Stream Box Score		4/30/2018	5/7/2018	5/14/2018
Performance Measures	*Number of Discharges*	*30*	*36*	*27*
	Median length of stay	*4.1*	*7.7*	*3.5*
	Median time of discharge	*11:25*	*11:26*	*11:30*
	Joy At Work Green/Black as %	*100%/0%*	*100%/0%*	*100%/0%*
	Days between Falls	*11*	*18*	*25*
	% Readmissions rate to any NHSH hospital	10%	9%	9%
Nurse Capacity	Direct care Day			46%
	Indirect Day			38%
	Available Time %			16%
	Direct Care Night			40%
	Indirect Care Night			40%
	Available Time %			20%
Financial Measures	Medical Pay Costs	£13,145	£14,670	£14,670
	Nursing Pay Costs (Excluding Bank)	£21,511	£21,831	£22,358
	Nursing Pay Bank Costs	£1,735	£2,092	£1,920
	Other Pay Costs	£0	£0	£0
	Drug Costs	£6,371	£5,782	£5,782
	Direct Clinical Care Supplies Costs	£2,686	£2,632	£2,632
	Other Non Pay Costs	£1,406	£1,457	£1,457
	Income	-£610	-£610	-£610
	Total Costs	£46,244	£47,854	£48,209
	Costs Per Patient	£617	£638	£679
	Total # pts seen	75	75	71
	Total costs excluding medical staffing	£33,099	£33,184	£33,540

Figure 2 Box score example. NHSH, NHS Highland.

by decommissioning beds or reducing staffing to the required level).

For the first step, teams used process standardisation methods (eg, value stream maps) that have been described elsewhere in the quality literature.[14–16] The second and third steps rely on three primary tools:

1. A 'box score'.
2. A specialised visual management board (VMB).
3. A weekly huddle practice.

The box score

The box score (figure 2), updated weekly, consists of a small set of measures of quality ('performance measures'), cost ('financial measures') and staff time utilisation ('capacity measures').

Teams select five to seven 'performance measures' by considering how their team contributes to the organisation's overall strategic priorities. Performance measures span across the major quality domains (eg, safety, efficiency, timeliness). Online supplementary file 2 describes how this is done.

Capacity measurement focuses on the dominant staffing needs of the clinical team. In a hospital setting, nursing staff often serve as the focus of capacity measurement. Teams measure three kinds of capacity: direct (time spent directly with patients), indirect (supporting activities, such as time for communication between providers) and available (the time left over). Capacity measurement helps teams identify opportunities for improvement, such as task elimination or simplification.

Finally, the box score includes 7–10 financial measures that reflect direct costs of day-to-day operations. Examples include full-time staff pay, agency nursing, drug costs and medical supplies. The total costs are summed and divided by the number of patients seen, yielding a cost per patient admitted to the ward per week. The financial measures do not include indirect costs, such as overhead that is generally out of the control of the front-line staff.

The VMB

The second tool employed by CVM is the Visual Management Board. Visual display of data is a key principle in QI[17] and lean accounting.[18] CVM uses a VMB format (online supplementary file 1) derived from lean accounting applications.

First, the VMB includes two elements to keep the team focused on organisational and team goals. Current and future state maps, derived from the standardisation efforts in step 1 of CVM, remind the team of its strategic direction. A representation of the organisation's overall vision may take the form of a graphic expression of the organisation's key strategies.

Next, the board features the box score. Teams select four to six measures from the box score for improvement work. For these measures, the VMB includes

run charts, Pareto analyses[19] and improvement project charters that target the main drivers of variation.

The weekly huddle

The final essential tool of the CVM method is weekly team huddles in front of the VMB. These huddles are carefully scripted 15 min meetings to review that week's data, along with associated analyses and improvement work. The team's manager (eg, a charge nurse) typically leads the huddle; front-line and supporting staff, as well as physicians, accountants and senior managers, attend.

Measures

The pilot care setting captured several performance measures in the box score during the testing period. The primary outcome measure was the cost per patient admitted to the ward per week. Secondary outcome measures included a set of quality, flow and satisfaction measures.

Quality ('performance') measures

Quality measures include measures of two types: overall quality (efficiency, safety, timeliness), termed 'performance measures', and 'capacity' measures—standard measures to capture how staff spend their time.

Safety, effectiveness and efficiency performance measures included per cent compliance with the 4AT bundle (the delirium screening tool endorsed by NHS Scotland), inhaler teaching within 24 hours of admission, days between falls, 28-day readmission rate to any NHS Highland hospital, the percentage of occupied patient bed-days for which the patient did not require an acute level of care, the number of patients boarded out to other units, the number of patients who required care in the unit who instead received it in other units and the percentage of non-specialty (non-respiratory) patients in the unit.

Flow-oriented performance measures included median length of stay, the number of patients seen per week, the number of discharges per week and median time of discharge (the median time at which patients left the ward to go home). The team lead collected these weekly using administrative databases and received support from an internal department ('Planning and Performance') charged with measuring quality for the hospital.

A performance measure focused on staff satisfaction measures was collected using a simple voluntary daily rating system of how the individual staff member's day went. These data were collected using voluntary staff surveys and reported as percentage of staff reporting a positive experience on a 3-point scale (positive, neutral, negative). Additionally, the team lead administered an online questionnaire including questions from the Agency for Healthcare Research and Quality (AHRQ) Patient Safety Culture survey tool,[20] along with open-ended questions. (The questions asked level of agreement with four statements: 'people support one another on my unit'; 'we have enough staff to handle the workload'; 'when a lot of work needs to be done quickly, we work together as a team to get it done'; and 'in this unit, people treat each other with respect'. The open-ended questions asked staff about the top challenges that cause them stress on the unit; their low point at work in the previous week; and their high point at work in the previous week.) Patient satisfaction data were collected using standard NHS Scotland patient satisfaction data collection methods. The team lead collected data for the other performance measures (safety, flow, and so on) using administrative databases and through manual tracking.

The box score included no more than eight 'performance' measures at a given time; as measures improved, they moved off the box score to control tracking and the team added new measures of interest.

The respiratory ward collected two sets of capacity measures: one for day shift and the other for night shift. The senior charge nurse developed a form that nurses carried with them during a shift to fill out to capture time spent on specific tasks. Initially, one nurse did this every shift, each day. After several weeks, the senior nurse averaged the data from several nurses' observations once per month.

Cost measures

The financial measures were obtained through the hospital accounting system. Nursing pay and agency nursing ('bank nursing') pay are calculated on a weekly basis based on the number of logged hours. Bank nursing includes nursing spend charged to the board for per diem nurses employed by the Board directly. The ward did not use agency nursing during the study period; these would be nurses employed by external agencies. The lead nurse finds information regarding the total number of hours worked for each grade in the human resources system and then converts these hours into a dollar sum using hourly rates. Drug costs, supply costs, income and other costs (eg, direct costs related to a special case) were accounted for on a monthly basis. These costs are divided equally by the number of weeks in the fiscal month, resulting in a weekly figure. The cost measures rolled up into a summative measure, cost per patient admitted to the ward (table 1).

Implementation

One of the CVM method developers from the IHI (JR) provided weekly coaching (a 1 hour weekly virtual call) from the beginning of the pilot through December 2018. Three IHI researchers attended two site visits at Raigmore Hospital in October 2016 and January 2017 to introduce CVM.

Throughout the study period, on a weekly basis, the respiratory ward team would complete the box score and update the VMB including the relevant Pareto

Table 1 Cost per patient admitted to ward, calculation

Component	Definition
Establishment nursing	Cost of full-time nursing staff employed directly by the facility
Bank nursing	Cost of nurses brought in at discretion of charge nurse to fill near-term staffing needs; employed by board
Drug costs	Cost of all drugs used on the ward, minus drugs used in respiratory outpatient clinic
Direct clinical care supply costs	Cost of items such as drains, intravenous tubes
Other pay costs	Cost of non-nursing ancillary staff such as housekeeper
Other non-pay costs	Cost of other items not related to direct patient care, such as training courses
Income	Revenue received by the unit by providing out-of-area service (eg, patients from other boards)
Cost per patient seen (referred to in text as cost per patient admitted to the ward)	For a given week of data, the sum of the other cost line items divided by the total number of patients admitted to the ward

analyses, PDSA forms and run charts. Two IHI coaches video conferenced into the weekly huddles and provided consultation. The senior sponsor, supporting physician and team accountant attended the huddles.

Dozens of tests of change, using Plan-Do-Study-Act (PDSA) cycles, were performed throughout the pilot-testing period. Table 2 summarises examples of some of these changes. The initial tests focused on cost reduction and included reduction in unnecessary utilisation of bank nursing and drug waste. Other PDSAs in subsequent months focused on improving productivity, such as the introduction of a midday huddle in addition to the existing morning and afternoon huddles to ensure timely completion of orders (eg, labs, pharmacy) leading to discharge.

Statistical analysis

Shewhart charts were created using Microsoft Excel QI Chart Add-In (V2.0.23) to monitor system performance and identify common cause and special cause variation. The investigators assessed changes in the measures to identify shifts in the mean over time. The researchers also performed two-sample t-tests comparing mean system performance prior to improvement work and after stabilisation of the process at a new level of performance assuming two-tailed distribution and unequal variance. For Shewhart charts, rules were applied from *The Health Care Data Guide*[21] to understand statistically significant shifts in performance. Only shifts including eight or more consecutive points above or below the mean were used to identify shifts; other special cause variation did not count towards 'shifts' in order to ensure conservative treatment of the data.

As the intervention being tested was a ward-level management intervention, there were no patient-level exclusion criteria. Some measures were added to the box score in months subsequent to the launch of the method, reflecting transition of other measures to a monthly control phase after showing statistical improvement. All patients admitted to the respiratory ward from October 2016 to May 2018, regardless of diagnosis, were included in the analysis.

RESULTS

From October 2016 to May 2018, a total of 5806 patients were seen in the respiratory ward of Raigmore Hospital in the NHS Highland (figure 3) (Boarders include patients seen initially on the unit,

Table 2 Examples of tests (PDSAs)

Box score domain	Test	Description
Performance	Delirium management	Introduction of a delirium identification bundle
Performance	Falls prevention	Increased supervision of patients during hours with disproportionate numbers of patient falls
Performance	Readmissions prevention	Introduction of telephonic social work follow-up for patients with at least one recent readmission
Performance	Midday huddle	Introduction of a midday team huddle to ensure all orders 'on track' to facilitate earlier discharge in the day
Capacity	Substituting tasks from day shift to night shift	Reallocation of paperwork activities to night shift in order to increase time spent during the day on patient education
Capacity	Redelegating indirect care to lower band nurses	Deploying lower band nurses to complete paperwork related to safety bundles to free higher band nurses for patient-facing activities
Finance	Replacing bank nurses with full-time nurses during unsocial hours	The senior charge nurse changed the rota to avoid scheduling bank nurses during unsocial hours (especially weekends)
Finance	Reducing drug waste	Tracking all drug orders on the drug supply cart to avoid duplicate orders
Finance	Switching to lower cost inhaler	Preferential use of lower cost inhaler in the inpatient service with equal outcomes, including patient education for effective use
Finance	Reducing wasted spend on toiletries	Replacing select items with lower cost alternatives

PDSA, Plan-Do-Study-Act.

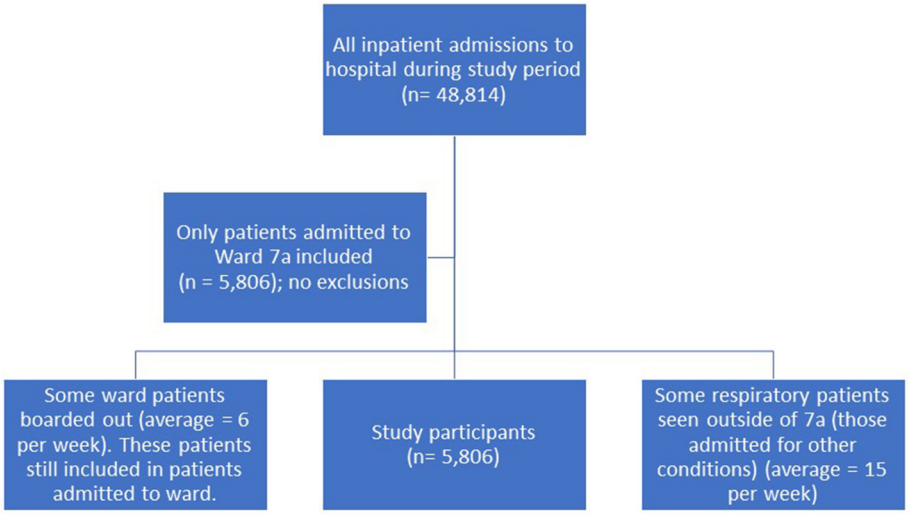

Figure 3 Consolidated Standards of Reporting Trials (CONSORT) chart.

but discharged to another unit awaiting discharge, givenmedical fitness for discharge).

Primary outcomes

From October 2016 to May 2018, cost per patient admitted to the ward on the respiratory ward decreased from a mean of £807.70 to £631.50 (21.8% decrease, p<0,0001) as demonstrated in figure 4A. This change triggers a special cause signal per Shewhart chart interpretation rules, and the control limits were revised to reflect new system performance. We also note a reduction in the variability of costs.

This outcome was due to two concurrent factors: an increase in productivity on the ward and a reduction in the cost of care. On the former, the average number of patients seen per week increased from a mean of 58.4 at the beginning of the study period to 75.3 (28.9% increase, p<0,0001); this special cause variation reflects a change in the system (figure 4B). Concurrently, the median time of discharge decreased from an average of 13:41 at the beginning of the study period to 11:32, a 2 hour-and-9 min difference (p<0.0001), which also shows special cause on the Shewhart chart (figure 4C).

On the second point, the cost basis of care, the largest cost category on this ward, was nursing costs. Over the duration of the pilot test, agency nursing ('bank nursing') costs for the ward also demonstrated a special cause signal (figure 4D); mean spending decreased from £2272 per week to £1572 per week (30.8% decrease, p=0.00271). Cost variability decreased and remained stable and predictable throughout holidays and influenza season.

Secondary outcomes

Staff satisfaction rates throughout CVM roll-out were consistently high among nursing staff. In July 2017, nursing staff in the respiratory ward reported positive experiences at an average rate of 95.6%. From August 2017 onwards, job satisfaction rates were an average of 98.8% (p=0.294).

As for the other performance measures, baseline compliance with the 4AT delirium screening tool was 14% in December 2017 and increased to over 85% by January 2018. COPD bundle compliance was 25% in January 2018 and increased to reach 100% by 20 February 2018. Both improvements continue to be

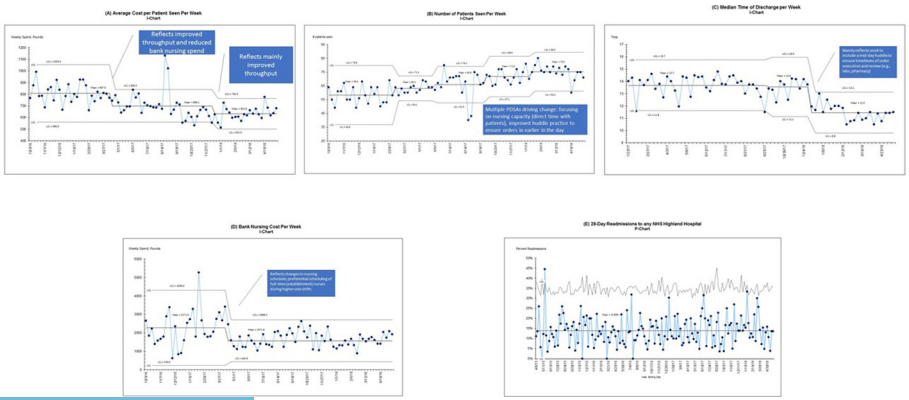

Figure 4 (A–E) Primary outcome and secondary measures, Shewhart charts, ward 7A, Raigmore Hospital. PDSA, Plan-Do-Study-Act.

monitored and sustained. Readmission rates were stable around 15% throughout the pilot (figure 4E).

The respiratory team outperformed teams not doing CVM with respect to patient falls. Between 2017 and 2018, this team saw a reduction in falls of 27.5%. By contrast, similar-in-kind medical wards not doing CVM saw an average reduction of 2.5%.

Data for several other measures did not show statistical change. The number of boarded patients fluctuated around an average of 6 per week. The percentage of occupied bed-days representing care that could have been provided in a non-acute setting fluctuated at an average of 10%. The number of patients who should have received care on the ward but instead received care elsewhere fluctuated around an average of 9 per week.

Baseline nursing capacity between November 2016 and January 2017 demonstrated that night shift nurses had 33.1% available capacity at the beginning of their evening shifts, while day shift nurses had only 17.5% available capacity. Sequential improvement activities improved productivity of both shifts and eliminated the disparity between them. Night shift took on administrative tasks, freeing up the day shift to spend more time with patients and families. The amount of available capacity for night shift nurses reduced to 19%, compared with 15% for day shift nurses.

DISCUSSION

In this single-site, non-randomised prospective study, the CVM method demonstrated effectiveness at lowering the cost per patient admitted to the ward while preserving or improving quality, patient and staff satisfaction.

Prior methods to improve value performance in healthcare have employed complex costing practices that are difficult to replicate in real time and require specialised consultant services and/or costly informatics systems to deploy.[12 22] In contrast, the CVM method uses existing staff within the system (finance, clinical and administrative) and requires no specialised information technologist or analytics consulting. The weekly cost, capacity and quality information provided to front-line teams was actionable as evidenced by the dozens of PDSA cycles conducted by front-line staff.

CVM reduced costs and increased productivity without negatively impacting staff engagement. This outcome resulted from strong leadership by ward nurse leaders, who prioritised teamwork and used team huddles to solicit staff input and celebrate success. The CVM framework deliberately involves staff in the operationalisation of organisational goals through the linkage charts (see online supplementary file 2) and provides constant feedback through weekly huddles, hence demonstrating that the work undertaken is good for the patients and beneficial to the organisation. Additionally, capacity measurement and workload redistribution directly involve staff in resolving the sentiment of overwork that may negatively impact joy in work. Given that increased staff engagement is correlated with lower turnover rates,[23] CVM may yield additional cost savings and stability through staff retention, although these effects have not been directly measured or reported in this study.

STRENGTHS

The application of the CVM method followed the pilot test protocol with fidelity to the original design. Continuity in leadership and coaching was an important strength of this pilot test. Executive sponsorship was essential and stable throughout the study period. Financial and clinical leadership was involved from the start, leading to will and buy-in from both the accountants and clinicians.

No other significant management interventions were introduced during the study period that would have added complication to the analysis. Another important strength of this improvement study was the quality and continuity of the weekly data flow which was uninterrupted throughout the entire study period. While a single-site investigation, the number of patients and the long duration of the study and the strength of the findings lead to greater confidence in the study conclusions.

LIMITATIONS

A major limitation of our work is the lack of randomisation or control groups. Since the study's conclusion, IHI researchers have compared overall financial performance of this pilot team to teams not implementing the CVM methods at Raigmore Hospital. Such teams receive monthly data regarding their expenditures relative to their budget. The inpatient respiratory team outperformed similar medical wards. In the year prior to the introduction of CVM, the respiratory ward incurred a significant deficit (£73 806). In its most recent year of work, reflecting nearly 2 years of applying CVM methods, it has changed this into a surplus of £34 924 (a net improvement of £108 730). Similar in-kind medical teams (other bedded units not providing surgical services) incurred an average somewhat below the inpatient respiratory team's deficit in the baseline year of £49 052. In the most recent year, these teams on average continued to run a deficit of £34 441 (a net improvement of £14 611). These changes support the notion of an independent positive impact on financial performance attributable to CVM.

The methodology explicitly incorporates balancing measures into the box score. Given the focus on cost reduction and efficiency, the team included at least one measure of safety in its box score and a measure of staff engagement. These measures did not decline during the study period, and staff satisfaction showed improvement.

The intervention itself did incur cost, in terms of consulting services and staff time. The senior charge

nurse spends 1–2 hours per week in ensuring timely completion of the box score and updates to the VMB. The assigned accountant spends not more than 30 min per week after identifying source data and clarifying operational definitions of the financial measures. Multiple line nurses, the pharmacist, the accountant and the team senior sponsor devote approximately 15 min per week to the huddle. Given that the routine intervention is not deeply time intensive, and the lack of a need to invest in expensive data analytics systems to support cost savings, these estimates suggest a positive return on investment for this work.

Not all measures showed improvement during the study period. Some measures (such as patients being seen on other units) were in the control of other teams (such as the emergency and admitting departments). Other challenges stemmed from broader systemic difficulties (patients lingering in the hospital after no longer needing acute care due to lack of community placements). A spread of the CVM approach to other teams (such as teams in community hospitals and to the emergency and admitting departments) would help address these problems.

A limitation given the small size of this pilot is the relative advantage this initial setting may have enjoyed: it had recently been through lean training, had a well-prepared charge nurse and a clinical champion. In addition, NHS Highland has a long-standing focus on building a culture of QI and patient safety. In 2007, NHS Scotland leaders founded a national programme, the Scottish Patient Safety Programme (SPSP), to improve patient safety throughout the system.[24] Highland has engaged in SPSP for over 10 years. Raigmore Hospital had also been working on lean implementation for 5 years prior to the CVM pilot test. However, early pilot work with this model in other healthcare settings suggests feasibility even with limited baseline improvement capability. Since the conclusion of this pilot, the CVM methods have been applied more widely at Raigmore Hospital and within the NHS Highland region. Early results from additional teams in a range of clinical settings, such as inpatient psychiatry, hospital outpatient care, inpatient cardiology (cath lab, step down) and intensive care units, suggest the feasibility of applying CVM across other contexts. Detailed evaluation of the work in additional teams is ongoing. Further comparative work to compare units with similar populations and contexts, perhaps through factorial study design, would more clearly highlight the impact of this method.

The approach taken in this pilot test did not allow for detailed understanding of precisely which PDSA tests were correlated with direct impact. That said, sequential PDSA rapid-cycle improvement allowed us to document challenges and learning acquired during programme development. Timing of changes such as the introduction of bank nursing scheduling, changed huddles structure and changed ordering practices, taken with the subsequent improvements, suggested that these changes plausibly impacted spend and productivity. In the future, incorporating planned experimental design may help quantify the impacts of specific changes.

Physician-level ordering did not serve as the focus of this work, unlike cost management strategies described elsewhere.[25 26] While physicians did support select improvement projects, it proved more feasible to focus on nurse-driven performance in areas like throughput and staff scheduling. Additional focus on physician ordering would increase the impact of this work and the savings opportunities. CVM might complement more prescriber-focused methods to reduce clinical variation, such as time-driven activity-based costing[22] and the application of 'big data' analytics to identify variations in ordering practices.[12]

The CVM method allows ward managers and hospital leaders to successfully apply QI methods to reduce the cost of operations while improving clinical performance. It also allows hospital leaders to coherently organise all improvement efforts to support both clinical quality and cost-related improvements. Further study is warranted and is under way to verify that the CVM methods are effective across other clinical settings and at a whole-hospital scale.

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