Program evaluation

2017–18 ‘Think sepsis. Act fast.’ scaling collaboration

BETTER CARE VICTORIA

ABOUT THIS REPORT

This is a comprehensive report evaluating the 'Think sepsis. Act fast.' scaling collaboration supported by the Better Care Victoria Innovation Fund.

We give an honest account of our design, approach, and performance. We share achievements and challenges experienced throughout the collaboration.

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Acknowledgement

Our office is based on the land of the Traditional Owners, the Wurundjeri people of the Kulin Nation. We acknowledge and pay respect to their history, culture and Elders past and present.

We value your feedback

Please email any feedback on this report to **communications@safercare.vic.gov.au**.

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EXECUTIVE SUMMARY

Sepsis is a life-threatening organ dysfunction in response to an infection. There is significant variance in practice in relation to sepsis recognition and effective resuscitation, with delayed recognition and initial appropriate treatment increasing mortality and morbidity (Singer et al., 2016).

The 'Think sepsis. Act fast.' scaling collaboration (the collaboration) was a 12-month semi-collaborative model of learning established by Safer Care Victoria (SCV) and funded by the Better Care Victoria (BCV) Innovation Fund in partnership with Melbourne Health (champion site) and 11 health services.

Each health service implemented a sepsis clinical pathway previously piloted by Melbourne Health in 2016–17. The clinical pathway was used to improve outcomes for patients with suspected sepsis through earlier identification and management.

The primary objectives of the collaboration were to decrease the rate of inpatient sepsis-related mortality, decrease hospital length of stay (LOS) for patients with sepsis, and decrease sepsis-related intensive care unit (ICU) admissions.

The secondary objectives of the collaboration were to ensure adherence to the sepsis pathway, decrease the time to antibiotic therapy, improve appropriateness of initial antibiotic therapy, demonstrate value for money, and engage consumers in the management of sepsis.

The aim of this evaluation is to report on key clinical outcomes and undertake an analysis of the approach and design of the collaboration.

KEY RESULTS

Data was collected for 2,942 patients across 10 health services (one health service did not enter data into the database due to lack of appropriate ethics committee approval). Data was collected over three phases: baseline, pilot and implementation.

Based on the available data and adjusting for age, severity, comorbidities, and accounting for clustering, the impact of the collaboration over three to four months is estimated to have:

- saved 52 lives
- avoided 96 ICU admissions
- reduced total hospital LOS by 3,781 bed days
- saved $11.7 million based on reduced LOS and reduction in cost
- demonstrated a six-fold return on investment.

There was a significant improvement in patient outcomes:

- 50 per cent decrease in mortality (11.4 per cent vs 5.8 per cent)
- 34 per cent decrease in ICU admissions (23.5 per cent vs 15.5 per cent)
- 51 per cent decrease in further ICU admissions (4.9 per cent vs 2.4 per cent)
- 1.2-day decrease in mean ICU LOS (4.6 days vs 3.4 days) and 0.1-day reduction in median LOS (2.8 days vs 2.7 days)
- 2.9-day reduction in mean total LOS (9.1 days vs 6.2 days) and 1.4-day decrease in median total LOS (5.6 days vs 4.2 days).

The collaboration's introduction of the sepsis pathway resulted in a significant increase in pathway adherence (4.9 per cent vs 78 per cent).

Key actions in appropriate sepsis management also significantly improved:

- 120.5 per cent increase in compliance with two sets of blood cultures (29.8 per cent vs 65.7 per cent)
- 43.1 per cent increase in venous blood lactate collection (59.6 per cent vs 85.3 per cent)
- 55.3 per cent increase in antibiotics administered within 60 minutes (37.4 per cent vs 58.1 per cent)
- 28.8 per cent increase in appropriateness of initial antibiotic therapy (61.1 per cent vs 78.7 per cent).

The use of a learning system approach, bringing together 11 health services to work toward a common goal, was a cost-effective way to change clinical pathways and resulted in improved patient outcomes.

Key recommendations from this evaluation:

- the BCV Board and SCV continue to support further expansion of the sepsis scaling collaboration across Victoria
- the sepsis pathway be introduced across the health system
- the SCV Infection Clinical Network oversees the expansion and adoption of the sepsis pathway across Victoria, including the system support required to sustain ongoing improvements
- this style of collaborative approach should be replicated when other system-wide initiatives need introduction.

INTRODUCTION AND CONTEXT

BACKGROUND

In 2016, an international consensus (Sepsis-3) defined sepsis as a life-threatening organ dysfunction caused by a dysregulated host response to infection (Singer et al., 2016). Sepsis can be triggered by an infection in any part of the body. Infections originating in the lungs, urinary tract, abdomen and pelvis are most common. In most cases, the immune response causing sepsis is triggered by a bacterial infection, although fungal, parasitic and viral infection can also lead to sepsis (Singer et al., 2016).

There are significant differences in how sepsis is recognised and managed. A delay in recognising and managing sepsis can increase mortality and morbidity (Singer et al., 2016). In 2016–17, there were 33,220 separations (28,872 patients with one or more of the sepsis diagnosis codes (Victorian Admitted Episodes Dataset, 2019). The difference between separations and patients is likely due to transfers between acute services and readmission. 3,258 of these patients died during their episode of care, giving an approximate in-hospital mortality rate of 11.2 per cent.

The Sepsis Improvement Project (described below) built on two previously successful implementations of a whole-of-hospital clinical pathway which demonstrated improvement in managing sepsis and patient outcomes. The Peter MacCallum Cancer Centre (PMCC) sepsis pathway adapted the New South Wales (NSW) Clinical Excellence Commission's 'Sepsis Kills' program for inpatient use and was implemented in 2013. The PMCC pathway resulted in decreased sepsis-related mortality (5 per cent vs 16.2 per cent), decreased admissions to the ICU (17.1 per cent vs 35.5 per cent) and saved more than $8,000 per patient on the pathway. The PMCC pathway also resulted in decreased time to antibiotic (55 minutes vs 110 minutes) and was sustained as routine hospital practice (Thursky et al., 2018).

MELBOURNE HEALTH SEPSIS IMPROVEMENT PROJECT

In 2016–17, the Sepsis Improvement Project (supported by the 2016–17 BCV Innovation Fund) adapted and spread the clinical sepsis pathway that was developed at PMCC for use across the Royal Melbourne Hospital (part of Melbourne Health).

The project implemented a clinical pathway and a multidisciplinary education package that was collaboratively developed for use across all services. The pathway standardised initial sepsis management, including clinical criteria for sepsis recognition and six actions in the 60 minutes following sepsis recognition: oxygen, two sets of blood cultures, venous blood lactate, rapid fluid resuscitation, appropriate antibiotic administration and continued monitoring. The pathway was a medical record document and supported nurses to initiate sepsis care.

The project decreased inpatient mortality (6.7 per cent vs 13.5 per cent), admissions to ICU (8.8 per cent vs 25.4 per cent) and LOS (4 vs 7 days), and improved process measures.

THE EMERGENCY CARE CLINICAL NETWORK SEPSIS BUNDLE OF CARE

The Emergency Care Clinical Network (ECCN) is a clinical network established by SCV. The ECCN brings together clinicians who deliver emergency care within urgent care centres, emergency departments and through Ambulance Victoria to improve the quality of care and patient experience in emergency settings.

The ECCN began the 'Implementing a sepsis bundle of care' project in 2016–17. The project implemented a similar bundle to that used in the collaboration with some differences. The project aimed to reduce variation in sepsis management,

standardise clinical practice, and enhance knowledge and capability of frontline clinicians.

In 2018, the project was expanded to urgent care centres, including 12 emergency departments and 20 urgent care centres. Health services were provided an emergency department or urgent care clinical pathway that was adapted from the 'Think sepsis. Act fast.' scaling collaboration, with 80 per cent of participating services successfully implementing the pathway during the project period. The 2018 project ran concurrent with the 'Think sepsis. Act fast.' scaling collaboration detailed below.

'THINK SEPSIS. ACT FAST.' SCALING COLLABORATION

The 'Think sepsis. Act fast.' scaling collaboration was a 12-month collaborative model of learning. The collaboration was established by SCV and funded by the BCV Innovation Fund in partnership with Melbourne Health (champion site) and 11 health services. The aim of the collaboration was to scale the sepsis pathway to 11 additional health services to improve outcomes for patients with sepsis. Each health service implemented a sepsis clinical pathway that was previously piloted by Melbourne Health in 2016–17. The learning system enabled peer-to-peer learning, rapid testing, trialling, and spreading of improvements.

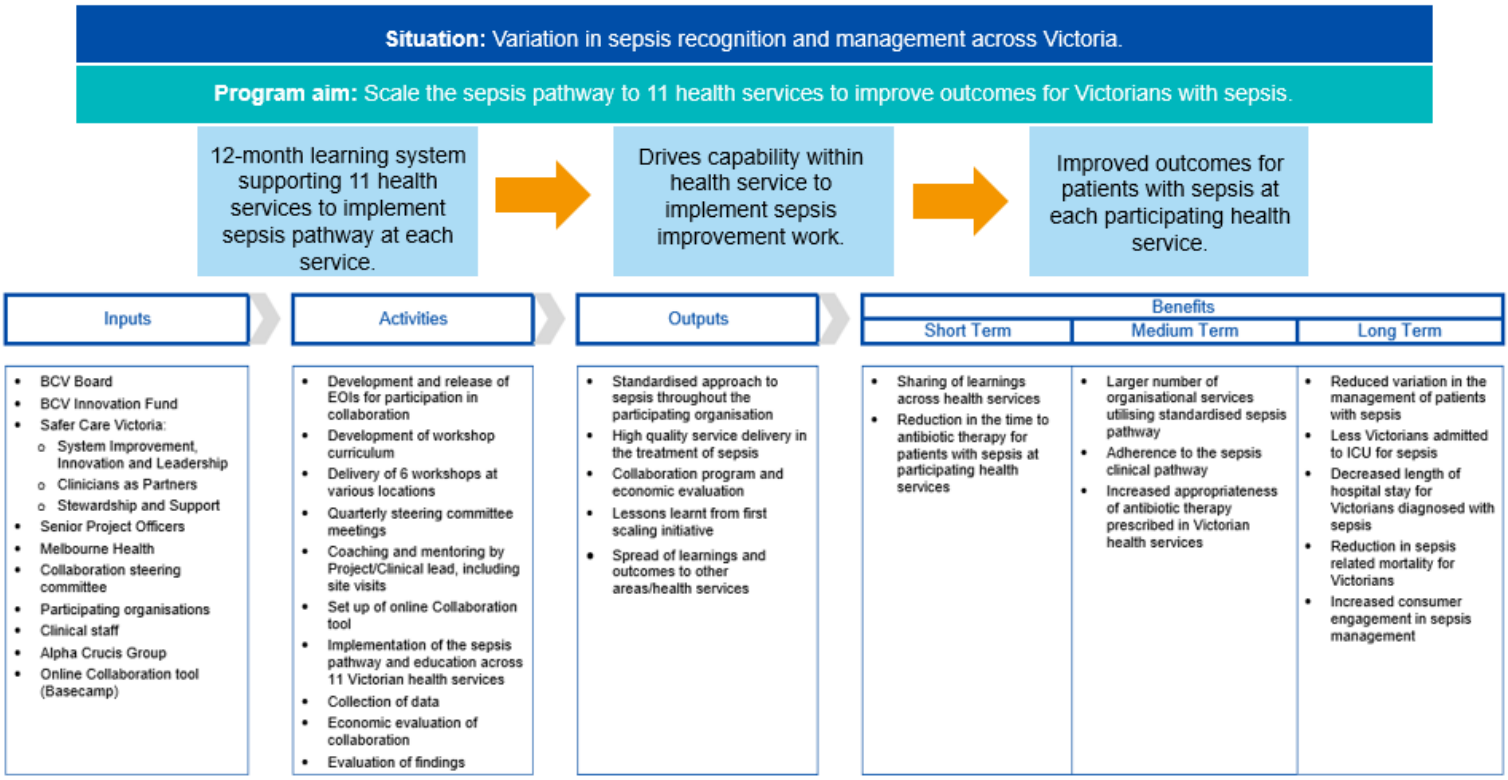
Participating health services

- Melbourne Health (champion site)
- Albury-Wodonga Health and regional partners
  - Beechworth Health
  - Corryong Health
  - Northeast Health Wangaratta
  - Yarrawonga Health
- Alfred Health
- Ballarat Health Services
- Barwon Health
- Bendigo Health
- Eastern Health
- Peninsula Health
- South West Healthcare
- Swan Hill District Health
- West Gippsland Healthcare Group

PROGRAM THEORY AND LOGIC

The program logic is an operational representation of the theory of change. It shows the chain of events needed to happen over time to achieve the program aim and focuses on resources, activities, outputs and outcomes (Figure 1).

Figure 1. Program theory and logic model



DESIGN AND METHODOLOGY

PROGRAM DESIGN AND KEY ELEMENTS

Based on a collaborative model of learning, the 'Think sepsis. Act fast.' scaling collaboration was a 12-month learning system that brought together teams from 11 health services across Victoria for the purpose of seeking sustainable, continuous improvement. The collaboration had a strong focus on guiding, supporting and encouraging teams, including senior leaders, to actively support and drive change. In turn, an improvement and innovative culture within the organisation was fostered.

A peer-to-peer learning approach was used in the collaboration. This involved a champion site providing the project resources, peer support and facilitated shared learning across participating services. Additional support was provided by the SCV System Improvement, Innovation and Leadership (SIIL) team.

The collaboration was governed by a steering committee comprising a range of experts from administrative, clinical and government positions.

Champion site

Melbourne Health was assigned to be the champion site responsible for developing capability and guiding implementation efforts. A clinical lead (0.2 FTE) and project lead (1.0 FTE) were recruited to oversee the change management process, address local barriers and risks, monitor project milestones, and assist in developing resources. Health services received support in the form of site visits, face-to-face meetings, one-on-one coaching, telephone, and electronic correspondence. Additionally, a database manager at 0.2 FTE was allocated for six months to manage the central database.

Participating health services

Participation in the collaboration required submission of an expression of interest (EOI) to SIIL. Only health services with an Innovation and Improvement Advisor were eligible to apply. All health services participated in the 2016–17 ECCN 'Implementing a sepsis bundle of care' project or had implemented a sepsis pathway in the past. Services were required to have a demonstrated interest in driving improvement with a high level of organisational readiness, clinical engagement and executive support. It was assumed that by submitting an EOI, health services prioritised sepsis as an area needing improvement.

Funding to health services supported the recruitment of a project officer (0.8 FTE) and clinical lead position (0.1 FTE) for 12 months at each service. These roles were expected to deliver the project in its entirety and act as sepsis champions in their hospital.

Strong leadership support was an expectation of participating health services, and all were required to nominate an executive sponsor position (in kind). This was to provide a clear point of escalation to project leads within their own health service. The executive sponsor's responsibility was to actively engage with the project team and assist with implementation by removing roadblocks where possible. After the conclusion of the project, the executive sponsor is expected to encourage and empower staff to undertake further improvement.

Resources

To ensure participating organisations were ready, each health service was required to complete a barriers and enablers assessment during the project planning stage (Appendix 2). Project teams were encouraged to revisit the assessment throughout the project to track progress and to assist in managing risk. Health services were

required to submit a final assessment at project closure to track progress made. The assessment was based on the experience of the 2016–17 Melbourne Health project and was separated into the following categories:

- people
- policy and process
- sepsis-specific process
- infrastructure
- additional.

Each category was rated on a scale from 'at risk' to 'complete'.

A series of four toolkits were developed by the champion site to support implementation. Resources in the toolkit were themed and disseminated based on anticipated project milestones.

A series of six face-to-face workshops were organised throughout the project to support project teams, build capability, and share learnings. The content of workshops varied, including health service updates, discussions, and lectures aimed at building capability based on upcoming project milestones. Key workshop topics included:

- introduction to the project, including clinical considerations, the Melbourne Health experience, and approach to scaling
- implementation approaches
- project and health economic evaluation
- consumer engagement (two workshops)
- data collection
- testing, piloting, and Plan Do Study Act (PDSA)
- sustainability
- World Sepsis Day and marketing
- spread and scale.

Site visits by SIIL and Melbourne Health project leads were made to provide individualised support and coaching.

An online platform called Basecamp was used as a project management and team communication tool to allow a central place for sharing resources and knowledge among health services. The tool served as the storage platform of documents, which enabled a 'one stop shop' for all services.

Project phases

The project was completed over a 12-month period and was separated into the following phases: planning, pilot (or small-scale testing), implementation, and sustainability.

The sepsis pathway

The collaboration did not develop a new sepsis pathway or guideline. The pathway provided to participating health services was based on the pathway used by Melbourne Health in 2016–17.

This initiative was designed to target the general, adult population. Health services were expected to adopt the clinical criteria and key actions detailed in the pathway (Appendix 3). Minor adaptations to the pathway were accepted to allow better alignment with requirements by the organisation and local antimicrobial guidelines.

The following definitions were used to recognise suspected sepsis:

- suspected or known infection plus two or more systemic inflammatory response syndrome (SIRS) criteria and/or
- two of more signs of severe sepsis (hypotension <100mmHg, altered mental state, and/or lactate greater than 2mmol/L).

The following definitions of sepsis will be used throughout the evaluation:

- sepsis: suspected or known infection plus two or more SIRS criteria
- severe sepsis: sepsis definition listed above with evidence of hypoperfusion (e.g. systolic blood pressure, elevated lactate)
- septic shock: requires inotropes to maintain blood pressure.

OVERVIEW OF EVALUATION

Two evaluation frameworks were developed to assist with the evaluation and were based on the Melbourne Health project:

- An organisation-specific evaluation framework to help participating hospitals work under a standard evaluation plan. This provided consistent data to inform a wider evaluation of the collaboration. A cost-effectiveness evaluation was undertaken for each health service.
- A collaboration evaluation framework to help SCV conduct an overarching evaluation on the impact of the collaboration. The outcomes from the organisation-specific evaluation framework were included.

The collaboration evaluation framework is the focus of this report.

An economic evaluation of the collaboration was also undertaken. The full report can be found in Appendix 1.

The economic evaluation was a cost-effectiveness analysis comparing patient cost and effect, pre- and post-implementation. The cost included health service expenditure for patients with an episode of care linked to sepsis and the costs borne by the BCV Innovation Fund in relation to the governance and implementation of the collaboration. An overview of the findings of this evaluation will be weaved throughout this report.

The collaboration had the following primary and secondary objectives:

Primary objectives

- Decrease the rate of inpatient sepsis-related mortality
- Decrease hospital mean and median LOS for sepsis-related presentations
- Decrease the rate of sepsis-related ICU admissions

Secondary objectives

- Ensure adherence to a sepsis clinical pathway further defined as:
  - binary yes/no patients with sepsis placed on sepsis pathway
  - compliance with key elements of the pathway: two sets of blood cultures, venous blood lactate, and antibiotics within 60 minutes
- Decrease the time to antibiotic therapy for sepsis management
- Improve appropriateness of initial antibiotic therapy (according to the empiric antibiotic guidelines)
- Demonstrate value for money (through economic evaluation)
- Engage consumers in the management of sepsis

This summative evaluation sought to address the primary and secondary objectives of the collaboration and includes process evaluation to assess the impact of the program design and key elements.

METHODS

A mixed methods approach was used for the evaluation. The method for data collection was as follows:

Quantitative methods

- Health services entered standardised clinical data fields into a centralised database (REDCap) to ensure consistent methodology
- Health services reported quantitative outcomes and findings in the final project status update reports to SCV
- Mid- and post-project feedback survey on quantitative data

Qualitative methods

- Mid- and post-project feedback survey on qualitative data
- Project activity tracker of Melbourne Health and SIIL support
- Basecamp (online collaboration tool) posts
- Semi-structured interviews with team members from participating health services
- Reported and recorded observations from Melbourne Health and the SIIL team
- Barriers and enablers assessments
- Health service reported qualitative outcomes and findings provided in the final project status update reports to SCV

Clinical data collection and analysis

The data collection periods for the baseline period were from September to December 2018. Cases were captured through a list of ICD-10 sepsis codes identified through the Victorian Admitted Episodes Dataset (VAED) supplied by the Victorian Agency for Health Information. Pilot and implementation phase episodes were identified through a combination of the VAED coding list and active surveillance.

Data was collected to determine location of sepsis identification, sepsis severity based on the collaboration criteria, clinical information about vital signs, pathology, antibiotic treatment, suspected or known infection diagnosis at presentation, final diagnosis at discharge, and patient outcomes such as LOS, ICU admission, readmission, and death.

During the collaboration, health services entered data into a centralised REDCap database. The database was hosted by the Royal Melbourne Hospital Business Intelligence Unit.

Each health service was required to enter data for the following phases: baseline, pilot (if completed), and implementation. After consultation with an epidemiologist, it was recommended that the minimum sample size for small hospitals (<100 beds) was 30 episodes. The minimum sample size for large hospitals (>100 beds) was 100.

A data collection form and data collection guide were developed and provided to each service to standardise the process. The data collection form (Appendix 4) included two pages of mandatory fields and two pages of optional fields. The focus of this evaluation compares baseline and implementation cohorts.

Descriptive analyses were performed on all data, but only baseline and implementation cohorts were included for significance testing.

Ethics

Multi-site ethics approval was completed through Melbourne Health, with each individual health service seeking local approval and governance to allow for data to be entered into the database. Bendigo Health did not complete a site-specific authorisation and therefore their clinical data was not included in the quantitative data analysis.

KEY QUANTITATIVE FINDINGS

CLINICAL CHARACTERISTICS

Cohort comparison

There was a similar higher proportion of males in all cohorts. This is consistent with published reports of sepsis and infection where there is male predominance (Table 1) (Angele et al., 2014 and Rhee et al., 2017).

Table 1. Cohort comparison

	Baseline n=876	Pilot n=590	Implementation n=1,476	p-value
Male n (%)	484 (55.3)	326 (55.3)	828 (56.1)	0.69
Age in years, mean	68.4	66.1	66.8	

Sepsis classification, clinical criteria and identification comparison

The introduction of a sepsis pathway led to increased recognition of patients with sepsis based on the collaboration criteria (Table 2). The average sepsis cases identified per 30 days was higher in the implementation cohort compared to baseline (43 vs 31). The increased detection is an expected finding of the collaboration as the sepsis pathway used an early warning diagnostic criteria (SIRS) in combination with recognition of known or suspected infection (e.g. pneumonia, urinary tract infection, etc.). The collaboration criteria also included a set of criteria for severe sepsis (i.e. two or more of lactate greater than 2mmol/L, systolic blood pressure less than 100mmHg, and altered mental state).

Table 2. Rate of sepsis identification after pathway implemented

	Baseline	Pilot	Implementation
Sepsis cases per 30 days, mean	31	39	43

The proportion of patients with sepsis and severe sepsis were comparable in the baseline and implementation cohorts (Table 3). The sepsis pathway implementation was associated with a decrease in patients classified with septic shock (-29 per cent). These findings suggest that with the use of a sepsis pathway, patients are being identified with and treated for sepsis earlier, decreasing the need for ICU admission and inotropes. Importantly, the use of SIRS-based criteria did not lead to an increased proportion of patients with less severe infection that would bias the results toward more positive improvements. There was a small proportion of patients coded with sepsis who did not meet sepsis criteria at presentation on record review, however 90 per cent of these cases had a final discharge diagnosis of sepsis. An important finding is that 30 per cent of cases did not have a temperature at presentation.

Table 3. Sepsis classification and clinical criteria comparison at presentation

	Baseline n=876	Pilot n=590	Implementation n=1,476	Risk ratio (95% CI) p-value
Sepsis severity				
Sepsis (SIRS plus infection) n (%)	548 (62.6)	409 (69.3)	975 (69.3)	1.06 (0.99–1.12) p=0.09
Severe sepsis n (%)	229 (26.1)	135 (22.9)	378 (26.6)	0.98 (0.85–1.12) p=0.77
Septic shock n (%)	67 (7.6)	38 (6.4)	80 (5.4)	0.71 (0.52–0.97) p=0.03
Criteria not met n (%)	32 (3.7)	8 (1.4)	43 (2.9)	0.80 (0.51–1.25) p=0.32
Clinical criteria				**p-value**
White cell count, mean (SD)	13.8 (10.1)	12.7 (9.6)	13.4 (17.4)	0.56
Neutrophil count, mean (SD)	11.3 (9.0)	11.3 (26.0)	11.3 (26.0)	0.87
Heart rate, mean (SD)	104.7 (22.8)	106.5 (21.8)	105.4 (21.3)	0.46
Respiratory rate, mean (SD)	22.9 (6.0)	23.6 (5.9)	23.3 (6.4)	0.16
Temperature in celsius, mean (SD)	37.8 (1.6)	37.7 (1.4)	37.9 (1.5)	0.13
Systolic blood pressure, mean (SD)	122.4 (30.9)	127.1 (26.2)	126.2 (26.5)	0.001

The majority (92 per cent) of patients were identified in the emergency department. In comparison to baseline, there was an increase in triage Category 2 sepsis patients (to be seen within 10 minutes) and a decrease in Category 3 (to be seen within 30 minutes) (Table 4). This supports using the sepsis pathway to ensure appropriate triage of patients with sepsis and completing key actions within 60 minutes. While over half of the sepsis cases were recognised at triage, patients were also recognised during routine observations and ward rounds within the department after the patient had entered the emergency department.

Table 4. Emergency department triage category and how sepsis was identified

Patient managed in the emergency department (ED)	Baseline	Pilot	Implementation	Risk ratio (95% CI) p-value
Patients managed in ED n (%)	808 (92.2)	540 (91.5)	1,360 (92.1)	
ED triage category				
1 n (%)	20 (2.5)	5 (0.9)	28 (2.1)	0.83 (0.47–1.47) p=0.52
2 n (%)	320 (39.6)	290 (53.7)	691 (50.8)	1.28 (1.16–1.42) p<0.001
3 n (%)	391 (48.4)	191 (35.4)	550 (40.2)	0.84 (0.76–0.92) p<0.001
4 n (%)	74 (9.2)	52 (9.6)	91 (9.6)	0.73 (0.54–0.98) p=0.04
5 n (%)	3 (0.4)	2 (0.4)	0 (0)	
Location of sepsis recognition in ED				
At triage	434 (53.7)	281 (53.9)	837 (61.5)	1.15 (1.06–1.24) p<0.001
Routine observations n (%)	209 (25.8)	130 (24.1)	272 (20)	0.78 (0.66–0.91) p=0.002
MET call n (%)	24 (2.9)	8 (1.5)	16 (1.2)	0.39 (0.21–0.74) p=0.003
Ward rounds n (%)	75 (9.3)	56 (10.4)	153 (11.3)	1.21 (0.93–1.58) p=0.15

Initial source of infection and final infection diagnosis

At presentation, the most common diagnoses were pneumonia, urinary, intra-abdominal and skin/soft tissue infections (Table 5). Medical record review of sepsis pathways demonstrated that 93.3 per cent of patients in the implementation group had an infection and sepsis diagnosis at discharge. This reinforces the performance of the collaboration criteria's sensitivity in predicting patients with infection and sepsis.

The final discharge diagnosis for all patients was ascertained by medical record review. It was also expected that the sepsis coding standard (defined mostly as blood stream infection, or a non-specific other category) would influence the frequency of sepsis diagnoses in the baseline cohort, and that the implementation cohort would be more representative of final diagnoses (Table 6). We do not have any information, however, about patients discharged from the emergency department.

Table 5. Infection source at presentation

	Baseline n=876	Implementation n=1,476
Suspected or known infection n (%)	741 (84.6)	1,216 (82.4)
Community-acquired pneumonia n (%)	222 (25.3)	479 (32.5)
Urinary n (%)	250 (28.5)	284 (19.2)
Intra-abdominal n (%)	65 (7.4)	137 (9.3)
Skin and soft tissue n (%)	81 (9.3)	109 (7.4)
Healthcare-associated pneumonia n (%)	34 (3.9)	61 (4.1)
Upper respiratory tract infection/influenza n (%)	23 (2.6)	44 (3.0)
Neutropenic fever n (%)	30 (3.4)	87 (5.9)
Bone and joint n (%)	15 (1.7)	12 (0.8)
Meningitis/central nervous system n (%)	10 (1.1)	15 (1.0)
Surgical site n (%)	12 (1.4)	9 (0.6)
<1% in both cohorts	Other systemic viral, necrotising fasciitis, IVC related, endocarditis	
Unknown source n (%)	135 (15.4)	260 (17.6)

Table 6. Infection and sepsis discharge diagnosis

	Baseline n=876	Pilot n=590	Implementation n=1,476	Risk ratio (95% CI) p-value
Clinically documented only n (%)	322 (36.8)	229 (38.8)	619 (41.9)	1.14 (1.02–1.26) p=0.01
Microbiologically diagnosed infection (blood stream) n (%)	284 (32.4)	102 (17.3)	305 (20.7)	0.64 (0.56–0.73) p<0.0001
Microbiologically diagnosed infection (non-blood stream) n (%)	216 (24.6)	171 (29.0)	356 (24.1)	0.98 (0.84–1.13) p=0.77
Sepsis without focus n (%)	46 (5.3)	35 (5.9)	97 (6.6)	1.13 (0.80–1.60) p=0.49
Sepsis excluded n (%)	8 (0.9)	53 (9.0)	99 (6.7)	7.33 (3.59–15.0) p<0.0001

PRIMARY OBJECTIVES

Sepsis-related mortality

All-cause crude inpatient mortality was reduced in all levels of sepsis severity in patients following implementation (Table 7). All-cause inpatient mortality reduced by 50 per cent from baseline to implementation. There were significant reductions in mortality for patients with SIRS with infection ($p<0.0001$) and severe sepsis ($p=0.007$). There was a 29 per cent reduction in patients with septic shock after sepsis pathway implementation and a 34 per cent reduction in admission to ICU. However, mortality remained high once patients were admitted to the ICU (i.e. requiring inotropes to maintain blood pressure). The pathway was not intended for use in the ICU.

Table 7. All-cause mortality by sepsis classification

	Baseline n=876	Pilot n=590	Implementation n=1,476	Risk ratio (95% CI) p-value
Overall all-cause mortality n (%)	100 (11.4)	40 (6.8)	85 (5.8)	0.50 (0.38–0.66) p<0.0001
Mortality by sepsis classification	**Baseline**	**Pilot**	**Implementation**	**Risk ratio (95% CI) p-value**
SIRS plus infection n (%)	47 (8.6)	17 (4.2)	31 (3.2)	0.39 (0.25–0.61) p<0.0001
Severe sepsis n (%)	35 (15.3)	18 (13.3)	31 (8.2)	0.53 (0.33–0.85) p=0.007
Septic shock n (%)	17 (25.4)	5 (13.2)	21 (26.3)	0.73 (0.38–1.38) p=0.34
Sepsis criteria not met	1 (3.1)	0 (0)	2 (4.7)	1.2 (0.1–13.0) p=0.88

Total hospital LOS

There was a significant reduction in LOS at implementation compared to baseline (Table 8). The median LOS for all sepsis-related acute admissions decreased from 5.6 days to 4.2 days – a 25 per cent or 1.4-day reduction. The mean LOS decreased from 9.1 days to 6.2 days, demonstrating a 31.9 per cent or 2.9-day reduction.

As discussed in the economic evaluation (Brusco and Sullivan, 2019, Appendix 1), this 2.9-day reduction in mean LOS has considerable cost savings. The baseline mean LOS had a mean cost of $22,107 (SD $26,937) per patient, compared to the implementation group, with a mean cost of $14,203 (SD $17,611). This is a significant $7,904 reduction in cost ($p<0.001$). The total cost for the baseline group was $19.4 million to service 876 patients, compared to the total costs for the implementation group which was $21 million to service 1,476 patients. The implementation group saved $11.7 million.

Table 8. LOS for sepsis-related acute admissions

	Baseline n=876	Pilot n=590	Implementation n=1,476	Change p-value
LOS days, median (range)	5.6 (0–82)	4.0 (0–143)	4.2 (0–127)	-1.4 days, p<0.001*
LOS days, mean (SD)	9.1 (10.3)	6.6 (9.6)	6.2 (7.9)	-2.9 days

**p-value calculated by Kruskal Wallis*

Sepsis-related ICU admissions

Overall, there was a significant decrease in ICU admissions, with most health services seeing a reduction in the number of ICU admissions (p<0.0001) and ICU LOS (p=0.02) (Table 9). Additionally, readmission during the same admission to ICU for a sepsis-related episode was reduced.

As discussed in the economic evaluation, the ICU cost also significantly reduced from baseline ($5,458) to implementation ($2,263) (p<0.001) (Appendix 1).

Table 9. ICU admissions*

	Baseline n=855	Pilot n=550	Implementation n=1,358	% change Risk ratio (95% CI) p-value
Initial admission n (%)	201/855 (23.5)	77/550 (14.0)	210/1,358 (15.5)	-34.0% 0.66 (0.56–0.79) p<0.0001
Further ICU admissions during same episode n (%)	10/201 (4.9)	2/77 (2.6)	5/210 (2.4)	-51.0% 0.48 (0.17, 1.38) p=0.16
LOS days, mean (SD)	4.6 (6.2)	3.3 (2.6)	3.4 (2.8)	-1.2 days p=0.02
LOS days, median (range)	2.8 (1–47)	2.6 (1–27)	2.7 (0.2–16)	-0.1 days

**missing data on ICU admission status in 179 patients*

Adjusted effect on primary objectives

The overall impact of the intervention at participating health services was assessed by estimating an adjusted intervention effect. This was applied to the baseline observed sepsis-related mortality, sepsis-related ICU admission, and hospital LOS.

Table 10. Adjusted effect*

	Baseline	Adjusted risk ratio*	Intervention	Difference	n	Events averted
Mortality	0.091	0.614	0.056	0.035	1,476	52.0
ICU admissions	0.203	0.679	0.138	0.065	1,476	96.2
LOS days	9.100	0.718	6.538	2.562	1,476	3,781.7

**adjusted for age, sepsis severity and Charlson Comorbidity Index, accounting for clustering by health service using Generalised Estimating Equations*

This suggests that at the participating hospitals over the three to four-month implementation period, the pathway was estimated to have:

- saved 52 lives
- avoided 96 ICU admissions
- reduced the total hospital LOS by 3,781 bed days.

SECONDARY OBJECTIVES

Adherence to sepsis pathway

Prior to the collaboration, despite all health services participating in the 2016 ECCN 'Implementing a sepsis bundle of care' project or implementing their own sepsis pathway, compliance was only 4.91 per cent. Using the collaboration methodology, compliance with the sepsis pathway increased to 78 per cent (Table 11).

Table 11. Adherence to sepsis pathway

	Baseline n (%)	Pilot n (%)	Implementation n (%)	Risk ratio (95% CI) p-value
On sepsis pathway n (%)	43/876 (4.91)	504/590 (85.4)	1,151/1,476 (78)	15 (11.85–21.2) p<0.0001
Emergency department n (%)	43/808 (5.3)	454/540 (84.1)	1,059/1,360 (77.8)	14.6 (10.92–19.60) p<0.0001
Wards n (%)	0/68 (0)	50/50 (100)	92/116 (79.3)	p<0.0001

Compliance with blood culture collection

A significant improvement occurred in both overall blood culture collection and number of blood culture sets taken (Table 12). In the implementation phase, approximately 94 per cent of patients had blood cultures collected (9.1 per cent increase). Overall, there was a significant improvement in blood culture collection (120 per cent increase) in two set collection and a reduction in one set and three or more sets. The biggest practice change in all health services has been from under-collection (one set) to collection of two sets of blood cultures, aligning with best practice guidelines (Dellinger et al., 2013).

Table 12. Compliance with blood culture collection

Blood culture sets collected	Baseline n=876	Pilot n=590	Implementation n=1,476	Risk ratio (95% CI) p-value
At least one set n (%)	754 (86.1)	547 (92.7)	1,386 (93)	1.09 (1.06–1.12) p<0.0001
Number of blood culture sets collected	**Baseline n=754**	**Pilot n=547**	**Implementation n=1,386**	**Risk ratio (95% CI) p-value**
0 n (%)	122 (13.9)	43 (7.3)	90 (6.1)	0.4 (0.31–0.52) p<0.0001
1 n (%)	500 (66.3)	142 (26.0)	430 (31.0)	0.47 (0.43–0.51) p<0.0001
2 n (%)	225 (29.8)	392 (71.7)	910 (65.7)	2.20 (1.96–2.47) p<0.0001
3+ n (%)	29 (3.9)	13 (2.38)	46 (3.3)	0.86 (0.57–1.36) p=0.53

Compliance with lactate collection

Collection of venous blood lactate improved from 59.6 per cent at baseline to 85.3 per cent at implementation (Table 13). Mean lactate levels were greater than 2mmol/L across all cohorts (and were greater than 2mmol/L in over 50 per cent of all patients). Lactate was greater than 2mmol/L in 77.1 per cent and 77.3 per cent in severe sepsis and septic shock cases, respectively. This compares to systolic blood pressure less than 100mmHg which was present at presentation in 37.1 per cent and

59.5 per cent and altered mental state 48.3 per cent and 43.8 per cent in severe sepsis and septic shock, respectively. Lactate appears to be an important discriminator for severe sepsis recognition and should be included as a mandatory initial test.

Table 13. Lactate compliance

	Baseline n=876	Pilot n=590	Implementation n=1,476	Risk ratio (95% CI) p-value
Lactate collected n (%)	522 (59.6)	537 (91.0)	1,259 (85.3)	1.43 (1.24–1.52) p<0.0001
Level, mean (SD)	2.8 (2.9)	2.4 (1.7)	2.3 (1.7)	p<0.001
Level, median (range)	2.2 (0.2–43)	1.9 (0.5–15.8)	1.9 (0.3–22)	

Time to antibiotic therapy

A key process measure for the collaboration was to improve time to first antibiotic dose. All health services saw a significant reduction in overall time to antibiotic (TTA) (Table 14) with most health services achieving a median time to antibiotic within 60 minutes both in the emergency department (Table 15) and in the wards (Table 16).

As more than 90 per cent of all sepsis patients were admitted through the emergency department, the TTA was significantly influenced by the triage category. Importantly, there was a 30.7 per cent increase in antibiotics given within 60 minutes in patients in the sickest category (Category 1) (Figure 2). Despite an improvement from baseline to implementation, only 58.1 per cent of patients received antibiotics within 60 minutes. There is still a need for further improvement to ensure all patients receive timely antibiotics.

Table 14. Time to antibiotic (TTA) from sepsis recognition in patients not already on antibiotics

	Baseline n=722	Pilot n=455	Implementation n=1,223	Risk ratio (95% CI) p-value % change
Antibiotics given within 60 minutes n (%)	270 (37.4)	280 (61.5)	710 (58.1)	1.55 (1.40-1.73) p<0.0001
Minutes, median (range)	78.6 (0–1,780.0)	45.9 (0–1,489.5)	48.1 (0–751.0)	-38.8%
Minutes, mean (SD)	116.2 (138.9)	71.9 (123.0)	69.2 (70.0)	p<0.0001 -40.4%

Table 15. TTA in emergency department

	Baseline n=739	Pilot n=477	Implementation n=1,233	% change
Minutes, median (range)	78.6 (0–1,699.0)	45.9 (0–1,489.0)	48.1 (0-751.5)	-38.8% p=0.0001
Minutes, mean (SD)	114.0 (125.4)	69.1 (69.4)	71.4 (123.9)	-37.4%

Figure 2. Time to antibiotics by triage category

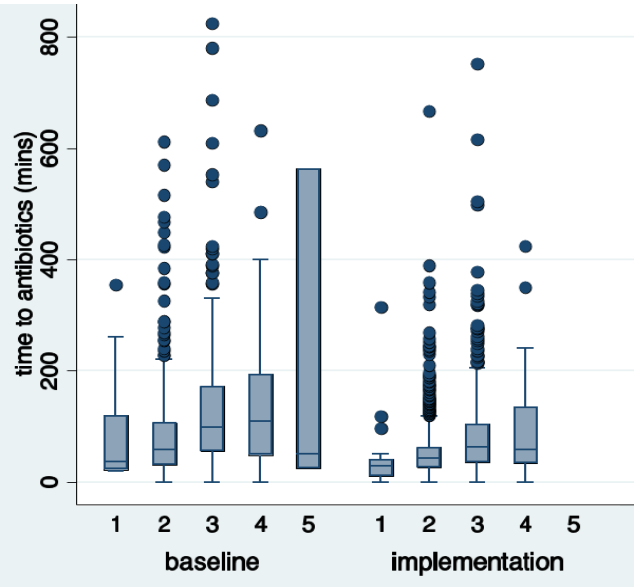


Table 16. TTA on wards from sepsis recognition

	Baseline n=68	Pilot n=50	Implementation n=116	% change
Minutes, median (range)	61.1 (0–1,780.0)	39.3 (0–495.0)	45.9 (4.4–460.9)	-24.9% p=0.09
Minutes, mean (SD)	145.8 (259.2)	79.2 (108.5)	70.2 (79.1)	-51.9%

Compliance with empiric antimicrobial guidelines

Each heath service modified the empiric sepsis guidelines according to their own case mix and in collaboration with the antimicrobial stewardship and/or infectious diseases service. The guidelines were embedded within the sepsis pathway document. Overall, there was a 28.8 per cent increase in compliance with empiric antibiotic guidelines from baseline (Table 17). The sepsis pathway included empiric antibiotic guidelines within the document to prompt clinicians to select antibiotics by suspected or known site and infection severity. A proportion of patients were already on antibiotics and were excluded from this assessment. The inclusion of guidelines was strongly liked by the medical and nursing staff and supported shared decision-making.

Table 17. Compliance with empiric antimicrobial guidelines

	Baseline n=820	Pilot n=532	Implementation n=1,368	Risk ratio (95% CI) p-value % change
Compliant with guidelines n (%)	501 (61.1)	406 (76.3)	1,076 (78.7)	1.29 (1.21-1.37) p<0.0001 +28.8%

KEY QUALITATIVE FINDINGS

CLINICAL RELEVANCE

Sepsis in Victoria

The collaboration successfully brought together 11 health services to address the widespread problem of variation in sepsis recognition and management. There are now 13 (including Melbourne Health and PMCC) health services that use a standardised pathway to recognise and manage sepsis.

Sepsis criteria

Several metropolitan services found adopting the collaboration clinical criteria challenging early in the project. Due to the wide dissemination of the updated Sepsis-3 criteria published in April 2016, there was a move to promote the quick Sepsis-Related Organ Failure Assessment (qSOFA) criteria as a sepsis screening tool, although it was not intended to be used this way (Singer et al., 2016).

While not the majority, a number of clinicians expressed concern that the collaboration criteria was too sensitive or that it did not align with previous sepsis initiatives or existing sepsis research at the health services.

Several large-scale evaluations of the qSOFA score published around the time of implementation did not support using this criteria as a screening tool as it misses a high proportion of patients with sepsis, although it was superior in predicting mortality (Serafim et al., 2018; Williams et al., 2017). Patients with sepsis often meet more than two SIRS criteria hours before meeting qSOFA (Churpek et al., 2017). For this reason, Sepsis-3 elements (hypotension, altered mental status, and elevated lactate) were included to identify patients with severe sepsis at risk of higher mortality.

The NSW Clinical Excellence Commission Sepsis Kills program, the UK Sepsis Trust, and the Surviving Sepsis Campaign have continued to use and recommend an early warning score (such as the SIRS or NEWS criteria). This information and the evidence of improved outcomes at both PMCC and Melbourne Health helped with buy-in for the utilisation of the collaboration criteria.

Several project teams reported it was challenging to implement this new criteria during the early stage of the project. Two health services reported that the EOI was not explicit enough to expect health services to adopt the criteria.

Standardising sepsis management

Victoria does not currently have a mandated sepsis protocol or standardised guidelines for health services to use. The collaboration provided a set of standard clinical criteria for recognising sepsis for the first time, and as expected, generated significant discussion and debate amongst participants across various clinical specialties.

Some health services reported that the requirement of adhering to the set clinical criteria resulted in decreased buy-in from their broader project team. Other health services reported that the expectations of adhering to the criteria was beneficial.

Metropolitan health services had a strong desire to develop their own service-specific sepsis guidelines. Regional health services felt better supported by a state-wide, mandated guideline.

> *"[Standardisation] would improve communication, consistency of care and ensure that each patient, at whichever health service, receives best practice-based care."*
> – Health service project officer

"[We] would prefer no discretion at health service level regarding protocols – they should be clinically workshopped at state level before implementation phase at health service level."
– Health service executive sponsor

The collaboration focused on the general adult population, and therefore the clinical criteria used to recognise sepsis did not account for subpopulations such as maternity, obstetrics and paediatrics. Both regional and metropolitan services participating in the collaboration showed interest in implementing a similar initiative across maternity, obstetrics, paediatrics and the aged care population.

As there is high interest in sepsis management in Victoria, developing sepsis guidelines for these targeted groups should be considered to reduce further variation if evidence exists.

ADDITIONAL BENEFITS

Key themes emerged relating to the non-measurable impact of the collaboration. These key themes are discussed below.

Awareness

While awareness was not a key measure for the collaboration, all health services reported an anecdotal increase in sepsis awareness. Services felt there was generally a low level of baseline sepsis awareness, contributing to the delay in recognition and management. Services said that the comprehensive communications plan and multidisciplinary education package resulted in increased awareness.

The collaboration provided an avenue of increasing sepsis awareness in an additional 11 health services across the state. Alongside the ECCN work conducted in regional Victoria, awareness of sepsis was promoted during this same period. The collaboration demonstrated that creating awareness is a crucial first step in reducing variation in sepsis management.

"[Before this project] the word 'sepsis' tended to only be used when discussing/ diagnosing patients with severe sepsis/ septic shock. Among clinical staff, sepsis was associated with critical care areas like the emergency department and the intensive care unit, but not with ward and subacute areas. Clinical staff in the ward and subacute areas had a limited understanding of sepsis, the treatment requirements for sepsis, and the timely manner with which sepsis needed to be recognised and treated."
– Health service project officer

"It was often difficult to find 'sepsis' written in patient notes during the pre-implementation data audit. However, the word 'sepsis' is now frequently used in daily dialogue and more noticeably in patient documentation since the implementation of the sepsis pathway."
– Health service project officer

Empowerment

All health services reported that the use of the sepsis pathway empowered key clinical staff. Nursing and junior medical staff reported that the pathway empowered case escalation to senior clinicians and allowed them to advocate for patient safety.

Nursing staff are key to driving sepsis identification, and the pathway helped integrate the expertise of nursing staff. It also provided them with the confidence to put forward not only a diagnosis that has clinical significance, but to initiate a lifesaving pathway of care.

"For those who [had] worked many years and to those who were new to clinical practice, it taught and empowered us more than we could have imagined. It actually evidenced clinical improvement – in front of our eyes."
– Health service project officer

"[Staff] felt they had a voice that they had not had prior. The nursing staff now have the ability to commence taking blood for pathology, insert an IV, and follow a clear path, and this was expressed as being empowering. The nursing staff reported an increased knowledge in identification and management of sepsis and feeling empowered to escalate the patient's condition to the medical staff. They felt that they had the correct terminology to have an educated conversation with the medical staff, to express the importance of why they felt it was sepsis, and what they had already implemented."
– Health service project officer

"By providing clarity surrounding use of a specific sepsis diagnostic tool, clinical staff (particularly nurses and junior doctors) felt empowered and confident to escalate care and treatment for septic/deteriorating patients. Clear parameters, treatment steps, and an antibiotic guideline assisted clinical staff to treat a deteriorating patient in a timely and efficient manner, whilst awaiting a more senior medical review."
– Health service project officer

Communication tool

A common theme emerging from health services was that the sepsis pathway acted as a communication tool. Services reported that the pathway facilitated effective communication and accountability with clinicians and consumers.

"Use of the word 'sepsis' in patient/family conversations is beginning to increase. Increased use of the word sepsis with patients/families and widespread profile-raising of sepsis in the community has aided in increasing community awareness of sepsis and the impact sepsis can have on the community."
– Health service project officer

Collaboration across areas

Health services were encouraged to effectively map key stakeholders and build multidisciplinary teams, due to the whole of hospital nature of this project. Services commonly said that this project promoted collaboration across various clinical and non-clinical areas in their health service.

"Our whole health service was engaged and interested in learning about what sepsis was, not just our clinicians but our ancillary staff too – that was a surprise. We held activities and competitions that brought the whole health service together (including financial services)."
– Health service project officer

"We felt involving the entire organisation allowed everyone to understand what we were trying to achieve for our patients and why."
– Health service project officer

"Tackling an organisation-wide complex problem was challenging with communication strategies being paramount to the success of the improvement project. Even though it was important to have project structure and processes, it was also vital to have open communication channels with staff to share information about goals, responsibility, performance, expectations, and feedback. Productive team communication was achieved through regular meetings, newsletters, workshops, and face-to-face interaction. Effective communication of key messages and actions play a big part in helping bring the project together."
– Health service project officer

Further workforce benefits

As the pathway supported nurse-initiated sepsis care, several health services used this as an opportunity to upskill relevant nursing staff.

As a result of this project, several services have extended the scope of practice or updated policies relating to nurse-initiated care. Where required, health services upskilled nurses in cannulation, blood culture collection, and use of rapid infusers for fluid resuscitation.

One health service also implemented an antimicrobial stewardship round in direct response to this project to monitor appropriateness of antibiotics.

PROJECT TEAM LEARNINGS

Use of real-time data and feedback

Data can be a useful tool for motivating stakeholders to support or change behaviour. Health services said that this project reinforced the value of data in stakeholder buy-in.

Services were encouraged to use baseline data to create a 'call to action'. Similarly, they were encouraged to provide regular feedback throughout the pilot and implementation stages to motivate clinician behaviour change. The feedback system reinforced pathway components, expectations and promoted continuous improvement.

"Staff engagement in the project greatly improved when data was provided to clinical staff that highlighted the positive impact the adult sepsis pathway was having on patient outcomes. Monthly data was provided to staff via emails, posters and presentations. Post providing this data, the project team noticed a large improvement in engagement, motivation and utilisation of the pathway from not only clinical staff but also higher levels of staff/management/executive. Further, continuing regular presentation of the data helped maintain long-term use of the pathway and helped embed use of the pathway into everyday practice."
– Health service project officer

"Ensure you have standardised and timely feedback processes to individuals, wards/areas, governance and executive. This will allow staff to see the impact of the change. This helps continue staff engagement, momentum, and continued utilisation of the pathway."
– Health service project officer

Engage with stakeholders early and often

The implementation of the sepsis pathway required organisation-wide changes. Therefore, it was essential to map and engage with stakeholders in the early stages of the project.

Communicating with key stakeholders early and often clearly helped support the initiative and mitigated potential risks.

"Involve clinical staff and consumers from the planning phase through to implementation and close of the project. Their involvement throughout the project lifespan ensures ownership and early identification of workflow issues and mitigation strategies."
– Health service project officer

"Engagement of clinicians is the key to success of any improvement initiative in healthcare. Creating a sense of urgency and the ability to make a change for the better of patients is fundamental to implementing change."
– Health service project officer

"[We] did not totally understand its current performance in relation to sepsis management before it implemented a version of Melbourne Health's pathway. In doing this, it struggled to make the case for engagement at the frontline at times."
– Health service Improvement and Innovation Advisor

Value in building a multidisciplinary team

Health services were encouraged to build a strong, multidisciplinary governance group to support the implementation of this project.

Representation from the following areas was encouraged: consumers, senior clinicians, antimicrobial stewardship, pharmacy, nursing, nurse education, emergency department, ICU, and other relevant specialties (surgery, etc.).

Reflecting on the collaboration one year later, health services reported that this multidisciplinary approach was essential to successful implementation and sustainability.

"Interdisciplinary teamwork was absolutely powerful. Getting an opportunity to work so closely with staff with completely different skillsets was inspiring and thought-provoking and genuinely created memories of seriousness, moments of tears from laughter, and a fantastic collaboratively driven successful project."
– Health service project officer

Testing small-scale change

All health services were encouraged to include a pilot phase in their approach to implementation. The pilot phase allowed for the pathway and education to be tested on a small scale and then refined based on feedback.

This concept was not initially embraced by all participating health services. However, the benefit of a pilot and PDSA cycles emerged as a key learning at the close of the collaboration.

"Initial use of the adult sepsis pathway among some areas/staff was met with scepticism and hesitation. By allowing clinical staff to have their say and provide feedback, staff began to engage in the pathway and support the use of the adult sepsis pathway. However, the greatest engagement came when staff saw that their feedback had been listened to."
– Health service project officer

"Piloting time is crucial to allow for feedback and pathway changes… piloting time is required to assess how it will be utilised and to ensure the right changes are made."
– Health service project officer

Need for leadership support

Senior leaders play a key role in quality improvement initiatives. Strong leadership and advocacy facilitate and promote the change

management process. The collaboration aimed to achieve this leadership support through the clinical lead and executive sponsor. As detailed below in 'Project management,' project teams reported that these roles were important in the successful implementation of this initiative.

Celebrate success

Services said that recognising and acknowledging success is an important component of quality improvement. This may be at an individual, clinical area and organisation level.

> *"Giving support and showing gratitude for a job well done helped foster staff engagement and boost morale and motivation."*
> – Health service project officer

PROGRAM DESIGN AND KEY ELEMENTS

Experience

The overall feedback of the collaboration was largely positive, with an overall rating of 4.3/5. More than 95 per cent of respondents reported they would participate in another collaboration.

> *"Health services are often working on developing the same processes or programs. The [collaboration] worked well as it presented the opportunity to share tools, resources, and learnings without duplication of effort. There was a great deal of support available throughout the project. We would encourage other health services to participate in the sepsis [collaboration] and/or other scaling [collaboration] projects as there are many benefits to sharing learnings for clinicians, patients, and the community as a whole."*
> – Health service project team

> *"Being a part of a broader [collaboration] was extremely valuable as it made it easier to exchange key learnings and ideas with other health services. This likely accelerated the pace of change and reduced the chance of repeating mistakes made by others. Participation in workshops and on platforms like Basecamp were key facilitators."*
> – Health service project team

> *"The future of sepsis in Victoria and Australia has been more positive because of this collaboration."*
> – Health service project team

> *"[This project] has resulted in an unprecedented organisational-wide engagement that has allowed for staff to work collaboratively despite their level of employment or knowledge. Working together to give better evidence-based care was our motto, and with the support of Better Care Victoria and the sepsis scaling collaboration, we have been able to implement an effective, efficient, and sustainable sepsis care project to rural clinicians, bettering the care received by Victorians."*
> – Health service project team

Organisational readiness

Organisational readiness was assessed in various stages, including in the EOI process, planning phase, and close. Health services were required to demonstrate strong alignment to the objectives of the collaboration and commitment to the initiative.

An organisational readiness tool, which identifies common barriers and enablers was used to track progress in overcoming challenges in the organisation. These tools demonstrated utility.

While a comprehensive EOI template was developed, the feedback from health services was that a stronger emphasis could have been placed on collection of baseline data. Providing data during the EOI would have established the needs of health services and SCV's expectations on providing data early in the process.

The Improvement and Innovation Advisor (IIA) supported the execution of the project and was a valuable resource, particularly in supporting inexperienced project officers. The IIAs acted as subject matter experts in improvement science, uplifting the capability of project officers to successfully implement the initiative.

Project management

The structure of project management in the collaboration included service-based project teams supported by centralised project leads. The role of the collaboration project leads, both at Melbourne Health and SIIL, were highly valued by participating health services.

The project leads spent a large amount of time (40 per cent) on coaching, mostly related to project management, change management and improvement methodology. While there was a strong focus on the clinical aspect of the collaboration, there was less support required in this area, likely due to the clinical lead role that each health service recruited.

Including the centralised project leads was essential to the successful program coordination of this size; these roles acted as both central coordination points, allowing communication from and to the sector. The project leads were able to synthesise information, share it with participating services and identify key problems needing to be resolved efficiently.

"Having a resource available to us that had great knowledge on the project but had also been involved in implementing it was invaluable."
– Health service project manager

Health service-based project teams are fundamental to implementing any health service change. The funding provided a project officer who was able to dedicate the entire EFT to undertake the project. While it can be resource intensive, organisation-wide changes like the sepsis program required the project officer to be a communication channel between participating services, SCV and their respective service. This part of their role was important to facilitate sharing of information and therefore appropriate in a sharing-focused collaboration using a model of improvement.

The limited lead time services had to recruit for the position resulted in delayed start times for some leads, with several missing the kickstart workshop. With the kickstart workshop being the main point of orientation to the project, it would have benefitted the project officers to attend.

"Without the project officer role, the sepsis pathway would not have been as successfully implemented. The project officer was vital to coordinating the roll-out as well as evaluating the impact. It was definitely a minimum of a full-time position and required for a project of this size."
– Health service clinical lead

Participating sites reported that the funding for a clinical lead was appropriate, effective, impactful, and efficient. The clinical lead was a key advocacy role and supported implementation across clinical areas. Services reported this role was beneficial to clinician buy-in and successful implementation.

Project teams agreed that the executive sponsor was appropriate, effective, efficient, impactful, and sustainable; however, less than the project and clinical leads. Engaging the executive sponsor varied by health services, and those with an engaged executive reported the role as a valuable resource. Other services reported that executive sponsors had limited engagement and did not offer much support throughout the project.

An executive sponsor meeting was coordinated by SIIL during the sustainability phase of the project, which the attendees found useful. A similar meeting could be considered earlier in the project to facilitate continued engagement.

> *"Having the direct executive sponsor support attributed greatly to maintaining clinical compliance from a medical perspective. We were encouraged as a team to report issues and concerns directly to the director of medical services, who actioned discussions promptly and appropriately with key medical staff."*
> – Health service project officer

Timeline and project phases

The most highly reported area for improvement for the collaboration was the timeline. The limited baseline awareness of sepsis resulted in the need to create sepsis awareness prior to education targeting behaviour change.

> *"Allow sufficient time for sepsis education, not just sepsis pathway education."*
> – Health service project officer

The sepsis pathway requires time-critical actions such as pathology testing and rapid fluid infusions. Services reported that they needed time to upskill nursing staff. These potential barriers are highlighted in the barriers and enablers assessment. However, including this assessment in the EOI period may allow these issues to be addressed earlier.

The phases were well received by project teams and drove shifting of focus in alignment with key milestones. Project teams reported that the pilot or small-scale testing period was beneficial and allowed for greater buy-in and improvements.

Capability building

Building capability for improvement is a core part of projects funded under the BCV Innovation Fund. The collaboration provided support, resources, and coaching to project teams to build capability for improvement.

After the collaboration closed, 82 per cent reported they had gained new project skills, with most feeling this was because of the support from the collaboration and not purely by completing the project.

This initiative was the first organisation-wide project implemented by most project officers. More than 90 per cent felt they gained confidence from the project to help them with delivering projects in the future.

For health services with formal improvement and project management methodologies in place, it was apparent that there was stronger ability to engage large numbers of stakeholders and manage timelines. For future cohorts, an opportunity is for formal improvement training, such as the Institute for Healthcare Improvement (IHI) Open School.

While a system responsibility exists to support improvement initiatives across health services, this requires the same level of accountability across health service organisations.

The collaboration confirmed that metropolitan, regional and rural health services with varying levels of capability can deliver improvement

initiatives. Services that did not demonstrate high levels of commitment or alignment with stakeholder expectations struggled to integrate the pathway into practice.

> *"This will empower you to be a leader within your organisation."*
> – Health service project officer

> *"Staff had the opportunity to enhance clinical and managerial skills throughout the project and this opportunity was welcomed. It created greater job satisfaction for those involved and allowed clinicians to be challenged in a manner that wouldn't readily present itself in a rural health service, all whilst being supported by the SCV and Melbourne Health collaboration leads."*
> – Health service project officer

Resources

Toolkits and templates

A range of written materials and templates were available to participants in the collaboration with significant investment early on by the Melbourne Health and SIIL project lead. Although time intensive to develop, the toolkits – including an education package, feedback tools and communication materials – demonstrated a return on investment because they reduced workload for project officers. This is key to a statewide effort to reduce duplicating and wasting time to create the same material in hospitals across the state. Overall, teams found the toolkits useful, rating them 4.12/5.

Templates such as the organisational readiness assessment effectively identified common barriers and enablers health services faced while implementing this initiative. By providing this assessment at the start of the project, it ensured that teams were engaging with appropriate stakeholders and developing risk mitigation strategies. It also allowed the central project leads to dedicate focused and individualised support.

Thematic analysis revealed that future toolkits should consider including electronic medical record (EMR) related resources, more details of the logistics and barriers faced by the champion site, and an overview of the ethics approval process. Further emphasis could also be placed on EMR and workforce structure (i.e. locums), as services identified these to be barriers to implementation.

Communication

Face to face

Networking and opportunities to share learnings are critical to drive statewide change. Most workshops in the collaboration used a didactic approach due to the volume of materials that was shared. It was later recognised that the workshops should be more interactive and encouraged in the future.

Health services found the workshops useful and particularly enjoyed hearing each health service's update. Standardisation of knowledge management was required centrally as this controlled the information.

> *"[Workshops gave] participants the opportunity to learn new skills, to network, gain knowledge and share learnings with staff from the other health services involved in the [collaboration]."*
> – Health service project officer

> *"[Workshops] were fabulous for learning, information sharing and team bonding."*
> – Health service project officer

Thematic analysis revealed potential gaps and an opportunity for future scaling rounds. Due to the lack of project management experience for many

teams, having a change management workshop may have been useful.

Similarly, several respondents said that a workshop dedicated to data collection would have been useful because it would offer those collecting the data an opportunity to discuss clinical scenarios and methods of collection. Teams also said that having more information or a session on the ethics approval process could have provided clarity on its status.

Attendance at workshops was consistent throughout the year. Much of the content delivered at workshops was directed at capability building for project leads. There is an opportunity to further engage clinical leads, possibly through case discussions.

Workshops were scheduled in advance of certain project stages to prepare teams. Follow-up interviews found that some sessions may have been delivered too early, such as sustainability. It is important to find the right balance between frontloading information and uptake.

Webinars can be an option in the future between workshop dates due to the large distance some health services had to travel.

Online

Health services were asked to evaluate Basecamp based on four components:

Interaction	4.1/5
Responsiveness	4.1/5
Finding information	4.1/5
Sharing information	4.2/5

Basecamp allowed project teams to contact others between workshops. It also allowed SIIL and Melbourne Health teams to have a centralised method for communication.

The platform also inserted an informal and social component to the program, where photos and videos could be shared. Apart from focusing on the project, a culture was cultivated where it was a safe place to share the achievements and challenges of delivering a project.

"[Basecamp] brings plausibility to the project."
– Health service Innovation and Improvement Advisor

Areas for improvement

Data and database

Feedback from most health services demonstrated multiple areas for improvement related to the data collection and entry process.

Data collection

The data collection guide aimed to provide operational definitions and clarity around key measures. Feedback from health services revealed the need to further improve definitions.

Several project officers reported ambiguity in definitions which led to avoidable confusion. This was also reflected in the activity tracker completed by the Melbourne Health project lead, with the type of support provided shifting to data collection queries.

Health services were encouraged to collect their baseline data during the planning stage; however, this was not mandated. Health services who did not collect baseline data during this period said that this was problematic.

A key learning from the project teams was the value in using data to encourage stakeholder buy in (see 'Project team learnings' on page 24). The availability of data early in the project would have assisted in creating a narrative around a 'case for change'.

"There was not enough time to collect baseline data prior to education and roll-out to help support the importance of a sepsis pathway, and not enough time to help clinical staff understand the overall significance of sepsis. It felt in some cases we were telling them how to fix a problem they didn't even know existed."
– Health service project officer

Health services also reported that the amount of data required put a burden on project officers. Health services who did not finish collecting baseline data in the planning phase were then completing this during the pilot or implementation stage, where their presence was required in clinical areas.

Database

A test phase preceded the official launch of the database where four health services trialled data entry and provided feedback. This testing phase proved valuable and several aspects of the database were updated before the launch.

The database was not officially launched until approximately five months into the collaboration due to building, trialling, and updating. Therefore, health services were unable to enter data and generate reports using REDCap. This resulted in some health services not collecting data and others entering data into an Excel file and later duplicating this process into REDCap.

Feedback surrounding the database revealed that data entry was cumbersome for users. Services said this process could be improved by reducing manual calculation fields, and maximising automated calculations, built-in data validation and errors notification.

Additionally, data cleansing should take place regularly to allow for rapid corrections. Services reported that the final data cleanse was too close to when the final report was due and revealed a high number of errors (as detailed in 'Data collection' on page 30). The immediacy between the final cleanse and report due date resulted in an avoidable reactive state for the project teams.

Electronic Medical Record (EMR)

Four of the 11 participating health services were implementing EMR during the project. The impact of EMR was underestimated in the project planning phase.

Two key learnings emerged relating to the concurrent implementation of EMR:

Competing priority

Implementing EMR across a health service is a large organisational change. Large organisational change disrupts the equilibrium at both an individual and organisation level and may result in 'change fatigue'. Therefore, it can be challenging to implement a hospital-wide change such as the sepsis pathway and EMR at the same time.

Integration of paper pathway into EMR system

The sepsis pathway tested and adopted for use in the collaboration was paper-based. At the time of the collaboration, there was no electronic-based algorithm or decision support tool for use by EMR-based sites that was consistent with clinical criteria on the paper pathway. Several automated sepsis algorithms and alert systems in EMR are available through Cerner Corporation, in particular the 'St. John Sepsis Surveillance System'.

Cerner was the vendor for all four health services that were implementing EMR during the project. This provided the SCV team with a unique opportunity to liaise directly with Cerner to explore the possibility of an algorithm aligning with the collaboration pathway. At the time of this

evaluation, a full analysis of the algorithm performance was not completed.

The four EMR-based health services were required to amend the initial scope of the project to account for EMR-related challenges. All four health services used a component of the paper pathway, later transitioning to an electronic-based system.

CONSUMER ENGAGEMENT

Each health service was required to engage with consumers and to report their involvement as part of the project. All services did engage consumers during the project, though the extent to which they were engaged varied.

Participating sites involved consumers in a variety of activities, including representation on steering committees, design and review of consumer information brochures, educational videos, and at promotional events.

Health services reported varying levels of engagement and consumer contribution throughout the collaboration. Participating sites with active consumer representation reported the value of the role and felt their involvement helped with the success of the project.

> *"Ensure a consumer advocate is involved in the project. A consumer advocate can provide the team with a unique perspective, highlighting areas of potential risk and solutions that otherwise would not have been thought of."*
> – Health service project officer

Other services that had difficulty with recruiting or retaining consumers, reported underutilising consumers in the project. A consumer representative teleconference was organised by SIIL during the sustainability phase with attendees reporting the session was useful in linking with other consumers and formulating key messages for health services.

Consumers discussed the value in sharing patient stories and working with other consumers when developing information brochures. They agreed there were challenges in sitting on steering committees and suggestions for improvement included having the consumer perspective added as a standing agenda item and options to review committee papers prior to meetings.

Consumer representatives said the word 'sepsis' needed to be used more when communicating with consumers and carers. They suggested the need for a public awareness campaign.

> *"The first time I hear the word sepsis shouldn't be on a death certificate."*
> – Consumer representative

Health services that reported on low levels of consumer involvement felt the project would have benefitted from more representation and input. This was reinforced by consumers who felt they would have liked to contribute more constructively to the project.

> *"Sometimes being a consumer rep at meetings can just feel like a tick box."*
> – Consumer representative

SUSTAINABILITY

It is important to ensure that the gains made in delivering effective and reliable sepsis management are sustained consistently into the future.

As part of the collaboration, participating health services were required to integrate the sepsis pathway into existing structures to ensure continuous monitoring and improvement beyond the formal end of the project.

Health services were encouraged to apply the National Health Service (NHS) Sustainability Model to help guide their approach to sustainability. The NHS Sustainability Model is comprised of three components (Maher, Gustafson, & Evans, 2017):

- process: monitoring progress, adaptability, credibility, and benefits beyond helping patients
- staff: training and involvement, behaviours, senior leaders, clinical leaders
- organisation: infrastructure, and fit with goals and culture.

Key strategies for each component of the NHS Sustainability Model are summarised below:

Process	■ Sepsis key performance indicator ■ Continued, simplified audits related to performance ■ Reporting measures to a committee ■ Integration into electronic systems ■ Continuation of pathway use
Staff	■ Continued training and education
Organisation	■ Sepsis policy

The key risk to sustainability was lack of overall ownership as reported by health services. While processes have been put in place across participating services to address the main components of the NHS Sustainability Model, without clear ownership and follow up there is the potential that performance will revert to baseline.

As detailed previously, there is an opportunity to standardise sepsis guidelines and reporting across Victoria, which may enable the improvements achieved in the collaboration to be sustained.

DISCUSSION

CLINICAL OUTCOMES

The magnitude of clinical improvement observed in the collaboration was concordant with the outcomes observed in previous whole-of-hospital implementations of the same pathway at PMCC in 2013, and Melbourne Health in 2016–17. The core principles of the pathway were to introduce a bundle of actions that supported:

- a whole-of-hospital approach to the recognition and management of sepsis
- implementation of early warning diagnostic criteria and measures of severe sepsis
- key actions to be completed within 60 minutes of recognition of sepsis
- utilisation of a medical record document to assist with standardisation of actions and appropriate documentation
- enabling of nursing staff at the point of care to initiate the pathway
- facilitation of high-quality handover of sepsis from the emergency department to the ward.

The overall impact of the pathway was assessed by estimating an adjusted intervention effect. Adjusting the data for age, sepsis severity, Charlson comorbidity index, generalised estimating equations and time, the pathway was estimated to have:

- saved 52 lives
- avoided 96 ICU admissions
- reduced the total hospital LOS by 3,781 bed days.

This suggests that the number needed to treat to save one life is 20 patients in hospitals with the pathway in place. This reduction in mortality attributable to the pathway and bundle of care reinforces the opportunity for the 'Think sepsis. Act fast.' program, if expanded across the state to improve outcomes for Victorians.

All-cause inpatient mortality was reduced by nearly 50 per cent (11.4 per cent vs 5.8 per cent) after implementation. There was a reduction in mortality across SIRS plus infection (-62 per cent) and severe sepsis (-49 per cent) classifications.

More than 90 per cent of all sepsis episodes fell into the SIRS plus infection or severe sepsis category, thus further reinforcing the potential of the pathway to impact mortality.

While the pathway did not result in a reduction in mortality for patients with septic shock (25.4 per cent vs 26.3 per cent), the number of patients admitted to ICU for the management of septic shock was reduced by 34 per cent (15.5 per cent vs 23.5 per cent) and mean ICU LOS was reduced by 1.2 days (3.4 days vs 4.6 days).

This implies that a key window for reduction of harm to people is the early identification of mild to serious sepsis coupled with timely treatment in order to stop sepsis progressing to the septic shock stage.

Once a patient was admitted to the ICU the mortality rate remained high. ICU management was outside the scope of this collaboration but should be considered in the future as there are additional implications on patient flow and hospital costs.

Hospital median LOS for sepsis-related admissions were reduced by 1.4 days, a 25 per cent reduction from 5.6 days to 4.2 days. The use of the pathway has implications on patient quality of life as multiple studies refer to reduced LOS leading to improve patient outcomes across multiple domains.

There was also a significant economic impact (Appendix 1). Based on reductions in LOS and cost, the pathway was estimated to have:

- saved $11.7 million based on reduced LOS and reduction in cost
- demonstrated a six-fold return on investment.

As demonstrated in the economic evaluation, the implementation of the sepsis pathway delivered better patient outcomes at a lesser cost. This was evidenced through reduction in LOS, ICU admissions and cost. The sepsis pathway demonstrated value for money and was cost-effective.

Considering the BCV Innovation Fund investment of $1.8 million, there was a six-fold return on investment (Appendix 1). Most importantly, there was a significant improvement in clinical outcomes for patients across Victoria.

Based on identification of patients by sepsis coding and active surveillance, 78 per cent of patients with sepsis were managed on the pathway following implementation (compared to 4.91 per cent in the baseline cohort). While active surveillance is time and resource intensive, the collaboration has demonstrated that investment more than pays for itself with improved patient outcomes.

Health services launched a sepsis communications campaign based on materials developed by the Melbourne Health team. It is likely the communications tool packaged in this awareness campaign is adequate to promote the update of the sepsis pathway across an organisation with appropriate coverage. However, as workforce training and education modules change in the future, improvements in this communication tool will probably be needed. The qualitative evaluation strongly supports the notion that uptake was largely influenced by the pathway actively engaging nurses in the coordination of the septic patient and strengthened a voice to advocate for patient care.

The clinical criteria used in the collaboration increased the identification of sepsis but did not lead to increased numbers of patients with less severe sepsis. This demonstrates the sepsis pathway did not lead to an increased proportion of patients classified with a milder disease, which some have previously argued would exaggerate the collaboration's improved outcomes. This supports continued use of the collaboration's approach.

The sepsis pathway correctly identified 93.3 per cent with sepsis as a final diagnosis at discharge, demonstrating the pathway criteria performed well in identifying patients. A key teaching point for the pathway is that the most important question is "Does the patient have suspected or known infection?" before applying the SIRS or severe sepsis criteria. Early identification is critical for sepsis management, and the pathway demonstrates appropriateness in identification.

Additionally, the collaboration supported the use of lactate as a key action and identification criterion. In both the baseline and implementation cohorts, the mean lactate level was greater than 2mmol/L, highlighting the importance of including lactate as a criterion. Until contradictory evidence emerges, the criteria used to recognise sepsis should be retained in future scaling.

Ninety-two per cent of sepsis episodes were identified in the emergency department. This suggests that focused efforts aimed at the emergency department are likely to continue to result in improved sepsis identification and management. Sustainable and ongoing clinician education should be considered, but it should also be noted that many state-led priorities target emergency departments.

Future initiatives should consider evidence of change fatigue and modify accordingly.

Key process measures were significantly improved with two sets of blood cultures (+120.5 per cent) and venous blood lactate (+43.1 per cent) using the pathway. This demonstrates that not only did the initiative improve awareness of sepsis, but also resulted in a change in clinician behaviour in ordering appropriate laboratory tests.

The most common sources of sepsis were community-acquired pneumonia in almost one-third of patients, followed by urinary tract infection, intra-abdominal infection, and skin and soft tissue infections.

The sepsis pathway calls for prompt antibiotic administration and there is a risk that the time pressure may result in inappropriate prescription of antibiotics. However, the collaboration demonstrated that as antibiotics administered within 60 minutes improved by 55.3 per cent, there was also an improvement in compliance with empiric guidelines (78.7 per cent vs 61.1 per cent).

Therefore, antimicrobial guidelines should remain a part of the sepsis pathway to ensure targeted therapy and antibiotic appropriateness. Future scaling should emphasise the importance of the link between antimicrobial stewardship and sepsis management.

The clinical criteria and pathway used in this collaboration was limited to the general adult population. An opportunity lies in the scoping of evidence-based guidelines for maternity, obstetrics, aged care and paediatric populations of Victoria.

The collaboration resulted in a real improvement in outcomes for Victorians with sepsis and there is a need to ensure the sustainable introduction of the pathway across the health system.

INFECTION CLINICAL NETWORK

The Infection Clinical Network (ICN) was launched in May 2018 and identified sepsis as a key priority area. The network will oversee long-term strategy of sepsis in Victoria.

With the development of the ICN, there is now a body to oversee the expansion and adoption of the sepsis pathway across Victoria. The ICN is well positioned to develop the system support required to sustain ongoing improvements.

CONSUMER ENGAGEMENT

Engaging consumers in the management of sepsis was a secondary objective for the collaboration. Services reported varying levels of engagement. While they all agreed that consumers play a vital role in improving quality of care, project teams were unsure how to do this in a meaningful way. The three key areas of consumer engagement that emerged from the collaboration were:

- at the bedside
- through project management activities
- public awareness.

Consumer engagement at the bedside primarily included the design and use of the pathway as a communication tool and development of information brochures.

Consumer project activities largely included representation on steering committees and reviewing materials. For future projects, consumer engagement should be a standing agenda item at steering committee meetings.

Consumer engagement should remain a core component for future scaling rounds. An opportunity lies in alignment of these methods for meaningful engagement with the SCV 'Partnering in healthcare framework'.

Several health services, mostly rural and regional, engaged with the community to provide general sepsis awareness sessions and information. However, there has not been a larger effort to engage the general public in the collaboration. The key learnings from the collaboration could be used in a general public awareness campaign if an opportunity arises.

Future initiatives should emphasise the importance of using the word 'sepsis' when communicating with consumers as stated by the consumer representatives participating in the collaboration.

PROGRAM DESIGN AND KEY ELEMENTS

A common challenge with scaling is finding the right balance between fidelity of the initial intervention and adapting it to a local context. Scaling this project has been a learning process. However, the intervention has largely maintained its effectiveness while being scaled across 11 additional health services.

The use of a learning system approach, bringing together 11 health services working toward a common goal was appropriate and successful.

While there are areas for improvement, the development of centralised resources promoted consistent messaging, reduced burden on project teams, and enabled health services to successfully implement this project without unnecessary duplication. These artefacts should be updated to more closely align with SCV's improvement strategy and IHI's Model for Improvement going forward.

Capability building is a core component of SCV's scaling strategy. Variation in project capability exists among health services. The need for improvement support at a health service level is critical to support project teams through organisational change. Centrally driven initiatives should consider formal improvement training for project roles through avenues such as IHI Open School.

Workshops, site visits, coaching, and the establishment of an electronic collaboration platform enabled capability building. Further emphasis could be made on change management and rapid improvement cycles.

Where possible, project teams should be linked with Innovation and Improvement Advisors to enhance rigour in project management. Active executive sponsorship is needed for success in change across an organisation and methods of regular touch points need to be considered at a central level.

There is a need to ensure commitment and readiness of organisations before involvement in a similar initiative. Health services should be encouraged to assess organisational readiness before their involvement. Similarly, a deeper understanding of baseline data prior to involvement should be essential to demonstrate the need for improvement. The inclusion of baseline data at the time of EOI will help to develop a case for change.

The use of data to drive improvement was essential for this project. There is an opportunity to strengthen the measures and operational definitions required. Where possible, data requirements should be lessened to reduce the burden on project teams. The use of real-time data collection and display over time rather than a before-and-after study design would better align to the model for improvement.

The impact of EMR implementation was underestimated during the scoping and planning phase of the collaboration. There was a need for wider stakeholder mapping to include those working on health service infrastructure and technology projects. Specific to sepsis, there is a

need to develop an evidence-based algorithm for EMR systems and resources related to the successful implementation of such an algorithm.

For future scaling, it is important that the learnings and 'sepsis champion' health services from this round are leveraged to ensure continued delivery and greater spread throughout Victoria.

CONCLUSION

This evaluation sought to analyse the impact of the 'Think sepsis. Act fast.' scaling collaboration. The collaboration was the first scaling initiative of the BCV Innovation Fund.

The key conclusion of the collaboration is that the sepsis pathway saved lives and improved patient outcomes.

In addition to improving patient outcomes, the collaboration demonstrated a significant return on investment.

This evaluation has provided recommendations that should act not as end points, but as starting points for continued improvement and spread to ensure that all Victorians receive appropriate sepsis management.

KEY RECOMMENDATIONS

Based on the evaluation of the 'Think sepsis. Act fast.' scaling collaboration, SCV recommends the following:

- the BCV Board and SCV continue to support further expansion of the sepsis pathway across Victoria
- the sepsis pathway be introduced across the health system
- the ICN oversee the expansion and adoption of the sepsis pathway across Victoria including the system support required to sustain ongoing improvements
- this cost-effective style of collaborative approach should be replicated when other system-wide initiatives need introduction.

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