Compendium of Electronic Medical Record (EMR) Benefit Measures

Digital Health

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Document sign off

Name	Date	Role
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Contents

Purpose

The Electronic Medical Record (EMR) benefits compendium is intended to:

1. provide health services with a reference set of benefit measures

2. draw together the current national and international evidence

3. consolidate the lessons from previous EMR implementations

4. enable state-wide monitoring of benefits across Victorian health services.

Background

Victorian health services and the Department of Health and Human Services (the department) have invested significantly in the digitisation of health care. This investment has contributed to the digital maturity of the sector and provides a foundation to transform health care through better information sharing, enhanced decision support and improved quality and safety.

Health care digitisation can improve both cost efficiency and quality of care through improved secure sharing of patient information for provision of care[1], easier and more timely monitoring and analytics, reduction in errors of transcription and legibility, and the generation of prompts, alerts and clinical decision support.

The Victorian Auditor-General's Office's (VAGO) 2013 report titled *Clinical ICT Systems in the Victorian Public Health System* stated 'there has been limited assessment to date of the benefits and outcomes of the various clinical ICT systems put in place by either the department or health services'[2]. The report highlighted that it is difficult to demonstrate that the investment in clinical ICT systems has improved patient outcomes.

In response to this report and to support health services in the development of future EMR business cases, the department's Digital Health branch has developed a compendium of EMR benefit measures. This compendium has been informed by the analysis of eight EMR business cases prepared by Victorian public health services and submitted to the department for funding.

Analysis of the business cases revealed that each health service approached benefit measurement differently with almost 200 benefit measured across these business cases. The benefit measures were aggregated into categories (79 in total) and then prioritised based on the frequency of occurrence. Comprehensive benefit profiles have been developed for the top 19 benefit measures as per the table 1 in the next section of this document.

This EMR benefits compendium is critical component to building the sector's capabilities in benefits realisation. This compendium provides a suite of potential benefits which are fit for purpose and reference the current evidence base.

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[1] Hillestad et al. 2005 – Health Affairs Volume 24, Number 5

[2] Victorian Auditor General's Office Report 30 October 2013 – Clinical ICT Systems in the Victorian Public Health System

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EMR benefit measures

Table 1: List of EMR benefit measures

Benefit Name
BM-001 - Improved consumer experience and outcomes
BM-002 - Reduced duplicate and unnecessary pathology test
BM-003 - Reduced duplicate and unnecessary diagnostic imaging tests
BM-004 - Reduced adverse drug events (ADE) caused by medication administration errors
BM-005 - Reduced adverse drug events (ADE) caused by medication prescribing errors
BM-006 - Reduced medication costs
BM-007 - Reduced cost of paper-based records and pre-printed forms
BM-008 - Reduced costs of scanning
BM-009 - Reduced software costs
BM-010 - Improved productivity – nursing staff
BM-011 - Improved productivity – medical staff
BM-012 - Reduced clinical and administrative staff time – information retrieval
BM-013 - Reduced time associated with discharge planning
BM-014 - Improved surgical throughput
BM-015 - Reduced emergency department length of stay (LOS)
BM-016 - Reduced inpatient length of stay (LOS)
BM-017 - Reduction in unplanned re-admissions within 28 days of discharge
BM-018 - Improved accuracy of private/compensable patients for billing
BM-019 - Reduction in clinical coding time

Benefit profiles

The following sections contains profiles for each benefit measure. Each profile is presented in a standardised format and details the rationale, calculation, source of the information and the specific EMR modules required to realise the benefit (as per the definitions below).

Field	Description
ID	*Unique benefit number*
Benefit name	*Short sentence summarising the benefit*
Description	*A description of the benefit detailing what it is and what it will deliver.*
Benefit type	*Financial or Non-financial* *Financial - benefits that can be quantified and valued in financial terms such as increased revenue or cost avoidance.* *Non-financial - benefits that are defined and measured in non-financial terms such as improved patient experience or improved staff satisfaction.*
Benefit classification	*Cash releasing or Non-cash releasing* *Cash releasing benefits that result in cash in the bank such as increased revenue or cost avoidance* *Non-cash releasing benefits that have a monetary value but do not result in cash in the bank such as improved productivity that frees up staff time to perform other tasks.*
Benefit category	*Benefit categories are based on the departments/health services strategic objectives/service delivery priorities.*
Planned outcome	*The outcome expected to be realised by the benefit.*
Rationale	*The reasoning for the benefit.*
Baseline	*The benefit measure at the commencement of the project.*
Benefit measure	*Metrics/indicators to be used to inform the estimation of each benefit.*
Calculation	*The calculation used to measure the benefit value.*
Target	*The expected reduction/improvement/saving as a result of the benefit.*
Reference literature	*List of referenced documents/studies/papers.*
Assumption	*List of assumptions on which the benefit valuation was based.*
EMR modules required	*List of EMR modules that must be implemented in order to realise the benefit.*
Risks	*Any potential risk associated with the benefit.*
Risk mitigation	*Actions required to mitigate the risk.*

BM-001 - Improved consumer experience and outcomes

Field	Description
ID	BM-001
Benefit name	Improved consumer experience and outcomes
Benefit description	The transition to an electronic medical record will reduce the incidence of repetitive questions being asked of consumers and their families and carers, as previously answered questions may negate the need. Improved discharge predictability, smoother transitions of care, better organised appointments and access to standardised and accurate consumer-directed information all add to increased satisfaction.
Benefit type	Non-financial
Classification	Qualitative
Benefit category	Improved patient experience
Planned outcome	Increased consumer participation, increased consumer health literacy, decreased wait times at discharge, less disruptive transitions of care, increased visibility of patient information and preferences to all staff.
Rationale	According to Victorian Healthcare Experience Survey (VHES): • 84% of survey respondents reported a delay in discharge, a factor decreasing overall satisfaction. Increased discharge predictability will result in less delays and increased satisfaction. • 78% of survey respondents report being told conflicting information from staff. Increased access to accurate information will reduce the likelihood of this occurring. Transitions of care (within and outside the hospital) require the collation of information and handover. EMR systems can streamline this process. Consumer-focussed written information can be embedded within the EMR, ready for provision to consumers and their families. Some systems include consumer portals and booking systems, allowing access at a time that suits the consumer.
Baseline	• VHES (Victorian Healthcare Experience Survey) results. • Other validated PREMs and PROMs tools available to service. • Complaints/compliments data.
Benefit measures	An increase in satisfaction, overall and at the individual VHES survey question level.
Calculation	
Target	
Reference literature	• Horvat, L 2019 Partnering in healthcare for better care and outcomes Safer Care Victoria (SCV) *The Partnering in Healthcare Framework* • VHES at www.vhes.com.au • Sentinel events reports.
Assumption	
EMR modules required	All modules may be tailored with a consumer focus. SCV recommends partnering with consumers during implementation to drive satisfaction improvements and to ensure the voices of consumers are heard.
Risks	
Risk mitigation	

BM-002 - Reduced duplicate and unnecessary pathology test

Field	Description
ID	BM-002
Benefit name	Reduced duplicate and unnecessary pathology tests
Benefit description	An EMR with electronic order entry and results reporting, will alert clinicians at the point of ordering, if they are about to order to a duplicate test. Clinicians have access to the patient's history of tests and clinical decision support can prevent duplicate ordering. Results can be graphed to show trends which may preclude over-ordering and duplicate testing.
Benefit type	Financial
Benefit classification	Cash releasing
Benefit category	Cost avoidance (in budget)
Planned outcome	• Electronic ordering of pathology tests • Reduction in unnecessary and/or duplicate pathology tests. • Avoid patients being subjected to unnecessary or duplicated medical tests or interventions
Rationale	Electronic order entry systems allow clinicians to see easily what tests have already been ordered and can also provide on screen warnings when a repeat test is about to be ordered within a specified timeframe. Clinical decision support features have the potential to reduce duplicate tests by notifying clinicians when there is an existing identical test order. Clinicians can then determine whether to override the alert and proceed with the order where clinically appropriate.
Baseline	Number of pathology tests (by type) ordered per annum pre-EMR implementation.
Benefit measures	• Number pathology tests ordered per annum post-EMR implementation • Average cost of pathology requests.
Calculation	Example calculation: [1]Baseline number of tests = 80,000 Target reduction = [2]5% [3]Average cost of pathology test = [2]$25 ([1]80,000*5%) *[3]$25= $100,000 saving per annum
Target	[x] % reduction in number of duplicate pathology tests
Reference literature	• The Royal Children's Hospital reported a 6.3% reduction in the number of pathology tests[3] • Canada Health Infoway estimated that there are 150 duplicate tests for every 1,000 pathology tests ordered (=15%).[4]
Assumption	Computerised Provider Order Entry (CPOE) i.e. electronic system used by clinicians to enter, modify, review and communicate orders, view results for laboratory tests, radiological images and referrals.

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[3] Pulse+IT HIC 2019: RCH reaping the benefits from its big bang theory

[4] Canada Health Infoway. Reduce Duplicate Test - In Canada, there are 150 wasteful duplicates for every 1,000 lab tests performed

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Field	Description
EMR modules required	- CPOE - Clinical decision support duplicate alert rule is configured - Alerts are programmed to exclude duplicated test ordering where there is an evidence base.
Risks	Clinicians may override alerts, particularly if alerts are not configured carefully with clinician engagement.
Risk mitigation	1. Educate clinicians about these alerts during training and orientation. 2. Monitor the number of duplicate pathology tests alerts are overridden. 3. Agree process for review of duplicate alerts.

BM-003 - Reduced duplicate and unnecessary diagnostic imaging tests

Field	Description
ID	BM-003
Benefit name	Reduced duplicate and unnecessary diagnostic imaging tests.
Benefit description	An EMR with electronic order entry and results reporting, will alert a clinician at the point of ordering, if they are about to order to a duplicate test. Clinicians have access to comprehensive test histories and clinical decision support to prevent duplicate ordering.
Benefit type	Financial
Benefit classification	Cash releasing
Benefit category	Cost avoidance (in budget)
Planned outcome	• Electronic ordering of diagnostic imaging tests • Reduction in unnecessary duplicate diagnostic imaging tests and associated consumable costs • Improved patient safety and experience through reduction in exposure to radiation.
Rationale	• Providing clinicians with access to prior results is expected to reduce the ordering of unnecessary tests • The clinical decision support has the potential to reduce duplicate test ordering by notifying clinicians when there is an existing identical test order. Clinicians can then determine whether to override the alert and proceed with the order where clinically appropriate.
Baseline	Number and types of diagnostic imaging tests ordered per annum pre-EMR implementation.
Benefit measures	• Number diagnostic imaging tests ordered per annum • Average cost of diagnostic imaging tests.
Calculation	*Example calculation:* Baseline number of tests = 500,000[1] Target reduction = 5%[2] Average cost of diagnostic imaging test = $75[2,3] (500,000*5%) *[3]$75= $1,875,000 saving per annum[1]
Target	[x]% reduction in number of duplicate diagnostic imaging tests
Reference literature	The Royal Children's Hospital reported a 12.5% decrease in diagnostic imaging tests.
Assumption	Computerised physician order entry (CPOE) is enabled.
EMR modules required	• CPOE and clinical decision support duplicate alert rule is enabled • Alerts are configured to ensure evidenced-based duplicate tests do not trigger an alert.
Risks	Clinicians may override alerts
Risk mitigation	• Develop strategies to review duplicate alerts • Create awareness of these alerts in clinician training and orientation. • Monitor the number of duplicate diagnostic imaging test alerts are overridden and reconfigure as required.

BM-004 - Reduced adverse drug events (ADE) caused by medication administration errors

Field	Description
ID	BM-004
Benefit name	Reduced adverse drug events (ADE) caused by medication administration errors.
Administration definition	Administering a medication in the wrong or unintended way (wrong patient, medicine, route, frequency, time, rate, dose or incompatibility). Administering a medication where the patient has a known drug allergy, where the medicine is contraindicated or clinically inappropriate. Administering a medication where the prescribed is not signed, or where the medication has been ceased or a dose should have been withheld.
Benefit description	The implementation of an electronic medication management module will reduce the risk of administration errors resulting in ADEs.
Benefit type	Financial
Benefit classification	Non-cash releasing
Benefit category	Quality and safety
Planned outcomes	• Improved safety and quality of medication administration • Reduction of ADE including those with potentially severe or fatal consequences.
Rationale	By implementing an electronic medication management module, a reduction in preventable ADEs is expected due to implementation of rules-based decision support at the time of ordering medications. An electronic medication management module can help reduce the number of administration errors by improving the accuracy and visibility of medication information. It enables best practice information to be more readily available to prescribers and improves linkages between clinical information systems.
Benefit measure	• Reduction in preventable ADEs caused by administration errors • Reduction in bed days associated with these ADEs.
Benefit baseline	Number of reported preventable ADEs per annum as per the Victorian Admitted Episodes Dataset (VAED), incident reporting and quality audits.
Calculation	Number of avoidable ADE per annum x target % reduction x cost per ADE.
Target	[x]% reduction in preventable adverse drug events caused by administration errors.
Reference literature	The introduction of an electronic medication management module at Peninsula Health was shown to deliver the following benefits: • Overall score on the Medication Safety Self-Assessment for Australian Hospitals (MSSA) improved from 71% in 2010 to 81% in 2013. • Documentation of known adverse drug reactions on the medication chart was 84.67% in 2009 compared to 99.19% in 2013. • Reduction in missed doses from 2009 to 2014: sub-acute 2.0% to 0.1%, acute 3.9% to 0.6% and mental health 6.0% to 0.7%.

Field	Description
	• 33% decrease in medication errors reaching the patient in period of 2013 to 2014. • 62% decrease in numbers of medication omissions dealt with by pharmacists in a 12-month period.[5] The Royal Children's Hospital report a 13.4% reduction in medication errors (prescribing and administration).[6]
Assumption	• Medication administration utilises the electronic medication management module. • The medication management module is compliant with the National Safety and Quality Health Service (NSQHS) Standard 4 Medication Safety. The Electronic Medication Management Systems: A guide to safe implementation (3rd edition) produced by the Australian Commission on Safety and Quality in Health Care.[7] • The availability of a nurse launching page enables nurses to see when medications are behind or when they have been missed.
EMR modules required	Core EMR and an electronic medication management module incorporating: • Dosing calculator (with dosing weight) • Allergy and drug-drug interaction checking • Barcode scanning technology for patient identification • Drug interaction alert • Dose range checking • Similar medication name notification.
Potential risk	Initial prescription could contain errors resulting in the wrong medication (dose, route etc) being prescribed and then administered to the patient.

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[5] Peninsula Health Clinical Systems Project Benefits Realisation Report V1.1 Final 2015

[6] HIC Melbourne 2019 – Professor Mike South - Clinical benefits of a Big-Bang EMR implementation RCH EMR Team – Slide 20 – Medication safety and published in Pulse+IT Aug-19 HIC 2019: Royal Children's reaping the benefits from its big bang theory

[7] NSQHS Standards – Medication Safety Standard

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BM-005 - Reduced adverse drug events (ADE) caused by medication prescribing errors

Field	Description
ID	BM-005
Benefit name	Reduced adverse drug events (ADE) caused by medication prescribing errors.
Prescribing definition	The process of issuing a prescription, writing an order on a medication chart, or authorising the administration of a medicine.
Benefit description	The implementation of an EMR results in a reduction of medication prescribing errors due to incorrect dosing, drug interactions, known allergies, incorrect medications and errors resulting from illegibility and misinterpretation. An EMR address the issue of prescribing errors by alerting prescribers to potentially drug interactions and known allergies which could impact mortality, morbidity and/or length of stay. Clinical decision support capability can prevent prescribing errors.
Benefit type	Financial
Benefit classification	Non-cash releasing
Benefit category	Quality and safety / productivity improvements
Planned outcomes	• Reduction in transcription errors Reduction in adverse drug reactions associated with prescribing errors • More efficient medication reconciliation • Electronic drug charts remove the requirement to re-write drug charts every seven days or when there is transfer of care between a wards or departments.
Rationale	An electronic medication management module can result in a reduction in errors due to transcription and legibility issues, that result in incorrect medications or doses being prescribed.
Baseline	• Medication audit data and incident reports: • Prescribing errors pre-EMR.
Benefit measure	Reduction in the number of prescribing errors.
Calculation	
Target	[x] % reduction in the number of prescribing errors.
Reference literature	A study in two acute care hospitals in NSW examining the effect of electronic prescribing on prescribing error rates was conducted by Westbrook et al between 2006-2010.[8] The study found a statistically significant reduction in error rates associated with use of the electronic medication management module within the three intervention wards at the two sites, with reductions of 66.1% [95% CI 53.9%–78.3%], 57.5% [95% CI 33.8%–81.2%] and 60.5% [95% CI 48.5%–72.4%].

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[8] The Safety of Electronic Prescribing – Journal of the American Medical Informatics Association

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Field	Description
	• Austin Health achieved a 50% reduction in the number of sub-acute ward medication incidents post introduction of electronic medication management module and 18.8% overall reduction in acute wards. • Austin Health also achieved a 100% reduction in errors related to illegibility, transcription, frequency and signing of orders post implementation. • The Royal Children's Hospital achieved a 13.4% reduction in medication errors prescribing and administration).
Assumption	• The implementation of an electronic medication management module will reduce the risk of prescription errors resulting in preventable ADEs through the implementation of rules-based clinical decision support at the time of prescribing. • An electronic medication management module can automatically calculate the final dose if a patient weight is documented. This mitigates the risk associated with manual calculations.
EMR modules required	• CPOE and electronic medication management module • Standardised prescribing protocols and clinical decision support drug- allergy, drug-drug, weight-dose rules implemented.
Potential risk	If alerts aren't configured properly (or are too restrictive) they may be over-ridden, clinicians may choose to proceed with the prescription of the drugs in circumstances when this is clinically appropriate, and the benefits outweighs the risk.

BM-006 - Reduced medication costs

Field	Description
ID	BM-006
Benefit name	Reduced medication costs
Benefit description	Reduction in medication costs due to the introduction of agreed cost-effective formularies and order sets.
Benefit type	Financial
Classification	Cash releasing
Benefit category	Reduced costs
Planned outcomes	Reduction in medication costs
Rationale	• Enables the prescriber to be prompted to use a lower cost pharmaceutical therapeutic equivalent within a same class. • The introduction of agreed generic medication formularies and order sets reduce clinical variation in medications and can lead to a reduction in overall medication costs. • Improves supply chain management i.e. using reports to review quantities administered vs dispensed, rather than stocktake.
Benefit baseline	• Annual medication costs • Average monthly cost on dispensed inpatient medications to wards pre-EMR implementation.
Benefit measure	• Actual reduction in annual medication costs • Average monthly spend on dispensed inpatient medications to wards post EMR implementation.
Calculation	1. The number of inpatient episodes *multiplied by* % reduction in costs due to use of an electronic medication management module with integrated computerised decision support prompting prescribers to select the most cost-effective medication *multiplied by* the average medication costs per episode. 2. Average monthly spend on dispensed inpatient medications to wards pre-EMR implementation minus average monthly spend on dispensed inpatient medications to wards post-EMR.
Target	[x] % reduction for each overall medication costs.
Reference literature	• The Royal Children's Hospital achieved a 2.1% reduction in medication costs. • Princess Alexandra Hospital QLD achieved a 14% reduction in medication costs.
Assumption	• Health services include therapeutic equivalents in order sets. • Clinical decision support and formulary restrictions are enabled to control the prescribing of medications. • The clinical system can be used to inform the pharmacy. department when to resupply medications to inpatients. This is completed using reports on quantities administered against the dispensed quantities, rather than relying on manually checking patients' medication lockers or medication charts.
Modules required	Electronic medications management module
Potential risk	Restriction/agreed formularies must be built into the EMR.

BM-007- Reduced cost of paper-based records and pre-printed forms

Field	Description
ID	BM-007
Benefit name	Reduced cost of paper-based records and pre-printed forms
Benefit description	The transition from paper to electronic medical records will reduce the costs associated with management of paper records, pre-printed paper forms and charts including a reduction in storage costs.
Benefit type	Financial
Benefit classification	Cash releasing
Benefit category	Cost avoidance (In budget)
Planned outcomes	Paperless (or paper-light) hospitals
Rationale	• Locating/sharing paper records can be difficult/time consuming. • Records are often misplaced or lost, and it is not possible to share a paper based medical record without copying it. The elimination of paper based medical records will provide a paperless or paper-light environment which reduces the expenditure on paper forms. • The storage of paper based medical records represents a large cost. As health information is sensitive, health records must be stored securely. This results in large, secured health record departments with many staff resources needed to manage and maintain health records and access to those records. • In addition to taking up space, paper records are not environmentally friendly and naturally deteriorate over time in storage, regardless of how well their environment is controlled.
Benefit measure	• Reduction in cost of printing paper-based forms and storage of paper-based medical records.
Calculation	• Reduction in the cost of pre-printed forms • Reduction in the costs of paper-based health record storage • Reduction in the cost associated with management of records • Reduction in cost of paper-based medical record security.
Target	[x] % reduction in annual expenditure relating to paper based records, pre-printed forms, request slips and clinical form printing costs and associated management and storage costs
Reference literature	• Princess Alexandra Hospital in Brisbane reported an 81% decrease in cost of clinical forms[9] • The Royal Children's Hospital achieved a 32% cost reduction associated with printed forms.
Assumption	
EMR modules required	• Computerised Provider Order Entry (CPOE) • Clinical documentation.
Potential risk	• Persistent use of paper forms i.e. non-compliance. • Paper based forms may be required as part of health service continuity planning.

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[9] QLD boasts of early win for Digital Hospital ieMR on MARS

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BM-008- Reduced costs of scanning

Field	Description
ID	BM-008
Benefit name	Reduced costs of scanning
Benefit description	Reduction in the costs associated with scanning paper-based forms and clinical documentation.
Benefit type	Financial
Benefit classification	Cash releasing
Benefit category	Cost Avoidance (in budget)
Planned outcomes	As documentation is digitised at the point of care, there will be a reduced need to scan paper-based forms and clinical documentation. This could result in a reduction in staff related costs.
Rationale	Clinical documentation to be collected electronically rather than via paper-based forms which require scanning. A fully integrated EMR has clinical and nursing documentation modules which enable direct entry of patient care information, thereby precluding the need to scan paper-based clinical records. This will impact on the staffing level required.
Benefit baseline	• Volume of records scanned annually • Cost of scanning per record.
Benefit measure	▪ [x]% reduction in the volume of records scanned annually ▪ Reduction of FTE required to support scanning.
Calculation	Volume of records scanned annually multiplied by target [x]% reduction in scanning volume multiplied cost [$] per record = $ X cost reduction
Target	$[x] reduction is costs associated with scanning
Reference literature	A benefits realisation report provided to the department 12 months post implementation of an EMR system at a large Melbourne tertiary hospital realised a $39.5K cost saving from not scanning medication charts rewrites alone (preparation time/filing time included).
Assumption	• Clinical documentation will be created digitally and will no longer require scanning to make it available electronically. • The process of scanning clinical forms and documents will no longer be necessary. • EFT associated with scanning can be redeployed (or made redundant).
EMR modules required	Clinical documentation
Potential risk	Workforce associated with scanning is unable to redeployed.

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BM-009 - Reduced software costs

Field	Description
ID	BM-009
Benefit name	Reduced software costs
Benefit description	Reduction in the cost of decommissioned legacy clinical systems, licencing, maintenance, infrastructure costs and support staff costs.
Benefit type	Financial
Benefit classification	Cash releasing
Benefit category	Cost avoidance (in budget)
Planned outcomes	Legacy software is decommissioned, and associated costs avoided.
Rationale	The EMR will integrate or replace functions provided by legacy systems.
Benefit baseline	Annual costs of legacy system/s in scope for decommissioning.
Benefit measure	- Abatement of legacy clinical systems annual software fees - Abatement of legacy software support and annual maintenance costs - Abatement of legacy software annual infrastructure costs - Abatement of legacy software annual support staff costs.
Calculation	
Target	[x] % reduction in legacy system annual cost.
Reference literature	The Royal Children's Hospital reported a reduction in software support costs for decommissioned clinical software.
Assumption	Legacy system/s decommissioned post EMR implementation
EMR modules required	Relevant EMR module that replaces legacy system functionality.
Potential risk	- Legacy system not decommissioned as planned resulting in increased costs. - EMR support costs may be greater than legacy software support costs. In this scenario the increased EMR support costs would be captured as a dis-benefit.

BM-010 - Improved productivity – nursing staff

Field	Description
ID	BM-010
Benefit name	Improved productivity – nursing staff
Benefit description	• Electronic medication administration saves nursing time by reducing documentation. • Biomedical device integration reduces documentation time with the automated electronic data population into the EMR i.e. vital signs and observations. • Reduction in hospital acquired complications (HACs) associated with central line-associated bloodstream infections (CLABSI).
Benefit type	Financial
Benefit classification	Non-cash releasing
Benefit category	Improved productivity
Planned outcomes	• Nurses will be released to perform other tasks based on time savings realised due to automated data capture. • Computerised interventions will promote compliance with proven best practices and prevent patient harm.
Rationale	• An EMR can enable nursing staff more time due to workflows, care pathways and templates. • Nursing staff are expected to benefit significantly from device integration at the bed-side, including automated electronic vital signs and observations. • Implementation of a fully integrated EMR can result in a significant reduction in nursing time spent on care planning tasks, a reduction in paperwork, time spent searching for documentation, recording patient observations and vital signs or waiting for assessment results.
Benefit baseline	Undertake a pre go-live observational study to measure: • Average nursing hours per shift for medication rounds • Average nursing time per shift to monitor and record vital signs and observations. • Number of HACs due to patients with intravenous line - CLABSI rates per 1000-line days pre-EMR
Benefit measure	Undertake a post go-live observational study to measure: • Average nursing time saved per shift for medication rounds • Average nursing time saved per shift to monitor and record vital signs observations. • Surveillance of HACs due to patients with intravenous line CLABSI rates per 1000-line days post EMR implementation.
Calculation	• (Average number of minutes saved per shift completing medication rounds x number nurses)/60 x average number of nurse shifts per annum x average hourly salary = $ x potential benefit value per annum • (Average number of minutes saved per shift due to medical device integration with EMR x number nurses)/60 (to convert minutes to hours) x average number of nurse shifts per annum x average hourly salary = $ x potential benefit value per annum.
Target	Number of minutes saved per nurse per shift

Field	Description
Reference literature	In 2005 the Journal of American Medical Informatics Association published a review paper which noted the use of bedside terminals and central station desktops saved nurses, respectively, 24.5% and 23.5% of their overall time spent documenting.[10] Austin Health report that nurses saved an average 10 minutes per day on medication rounds (24% reduction). This consisted of less time searching for medication charts, querying medication orders and fewer interruptions during medication rounds. Use of an EMR-enhanced CLABSI prevention checklist coupled with a unit-wide real-time display of adherence was associated with increased compliance with evidence-based and sustained decrease in CLABSI rates.[11]
Assumption	Devices integration with the EMR replaces the manual process of recording vital signs and observations.
EMR modules required	Electronic medication management module, device integration and clinical documentation.
Potential risk	• Nurses reverting to use of paper-based documentation. • Inability to realise these efficiencies due to nursing ratios.

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[10] Journal of American Medical Informatics Association – The Impact of Electronic Health records on Time Efficiency of Physicians and Nurses: A systematic review – Sep/Oct 2005

[11] Use of electronic medical record enhanced checklist and electronic dashboard to decrease CLASBIs

BM-011 - Improved productivity – medical staff

Field	Description
ID	BM-011
Benefit name	Improved productivity – medical staff
Benefit description	An EMR facilitates improved productivity of medical staff through a reduction in time spent searching and retrieving patient information and enabling multiple staff to an access the same record simultaneously. Access to comprehensive, centralised structured real time patient information is available from any networked locations including mobile devices.
Benefit type	Financial
Benefit classification	Non-cash releasing
Benefit category	Improved productivity
Planned outcomes	Freeing up of medical staff time
Rationale	• Patient information available to multiple clinicians • Fast and easy to find • Clear overview of whole patient • Remote access to data via PC/iPad/smartphone.
Benefit measure	• Staff survey to gauge perception of average medical staff time saved searching for patient information per shift • Time and motion study based on common clinical scenarios e.g. ward round.
Calculation	Time and motion study
Target	
Reference literature	
Assumption	The EMR has the executive and senior medical staff support.
EMR modules required	
Potential risk	New medical staff unfamiliar with the EMR may be less efficient creating a dis-benefit.

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BM-012 - Reduced clinical and administrative staff time – information retrieval

Field	Description
ID	BM-012
Benefit name	Reduced clinical and administrative staff time - information retrieval
Benefit description	Reduction in clinical and administrative staff time spent on retrieving and maintaining paper-based medical records.
Benefit type	Financial
Benefit classification	Non-cash releasing
Benefit category	Improved productivity
Planned outcomes	Patient information is easily accessible and available remotely via PC/Smartphone/iPad/Tablet etc.
Benefit baseline	Time in motion studies performed pre EMR implementation, e.g. time to order a test, preparation time for ward rounds.
Benefit measure	Time in motion studies performed post EMR implementation to determine percentage change in time to perform the same tasks.
Calculation	
Target	
Rationale	The use of paper-based medical records results in fragmented, inconsistent information which is difficult to locate or is missing. As patients move through the hospital during their stay the same clinical information is often re-written multiple times resulting in duplication of effort. This practice also poses a risk to patient safety due to lack of a single source of truth and unavailability of information relating to allergies or other alerts. An EMR will result in a single source of truth that is easier to navigate.
Reference literature	
Assumption	EMRs provide instantaneous access to a patient's health record without the need to send a retrieval request to medical record staff or other departments.
EMR modules required	Clinical documentation
Potential risk	There are single encounter issues with EMR across sites with the need to re-write orders and medicines if the patient move is transferred to another health service or facility.
Risk mitigation	

BM-013 - Reduced time associated with discharge planning

Field	Description
ID	BM-013
Benefit name	Reduced time associated with discharge planning.
Benefit description	Reduction in time taken by clinicians to produce and release discharge summaries.
Benefit type	Financial
Benefit category	Non-cash releasing
Classification	Improved productivity
Planned outcomes	• Automatic uploading of results and pre-configured clinical documentation to the discharge document will reduce the time required to produce a discharge summary • Electronic discharge summaries have the potential to reduce discharge medication errors to increase the safety of clinical handover of care between facilities and care settings. • Improve flow of information between facilities and care settings • Reduced time spent waiting for discharge summaries and referrals.
Rationale	• Paper-based discharge summaries are not automatically sent through to general practitioners or other facilities and require ward clerks to manually fax or mail. • There is an increased risk of medication error during transfer of care between hospital and community settings. A 2009 National Health and Hospitals Reform Commission final report stated that an estimated 52–88% of transfer documents contain an error.[12] • An electronic discharge summary auto-populates patient information (medications, allergies, ADEs, medical /surgical history) into the discharge summary reducing the administrative burden when compared to paper-based discharge summaries.
Benefit baseline	Time in motion study to measure the average time taken to produce paper-based discharge summary.
Benefit measure	Time in motion study to record time taken by clinicians to produce a paper-based discharge summary versus time take to generate an electronic discharge summary.
Calculation	[1]20 minutes per shift (junior doctors) multiplied by the [2]number of junior doctors (161) converted to [3]hours, multiplied by [4]average number of junior doctor shifts per annum (240), multiplied by [5]junior doctors' annual average hourly salary ($52.00) = [6]forecast benefit value $ p/a *Formula:* ([1]20*[2]161)/[3]60*[4]240*[5]$52.00=[6]$669,760 = potential benefit value per annum.
Target	[x] % decrease in the time taken to complete a discharges summary
Reference literature	Australian Commission on Safety and Quality in Health Care - Electronic Medication Management Systems — A Guide to Safe Implementation (3rd edition).[13]

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[12] National Health and Hospitals Reform Commission. A healthier future for all Australians: National Health and Hospitals Reform Commission final report. Canberra: Australian Government Department of Health; 2009 (page 186)

[13] Australian Commission on Safety and Quality in Health Care. Electronic medication management systems: a guide to safe implementation. 3rd edition. Sydney: ACSQHC; 2017

Field	Description
Assumption	- The EMR will reduce in the time taken to prepare a discharge summary, resulting in reduced clinician time carrying out discharge tasks. - An electronic discharge summary is pre-populated with information from the electronic medication management module. - Capability to electronically send electronic discharge summaries to general practitioners and other care providers. - Capability to uploading electronic discharge summaries to My Health Record. - Provision of a patient friendly discharge summary with additional patient information.
EMR modules required	Electronic discharge, electronic medication management module
Potential risk	Increased volume of clinical information may result in electronic discharge summaries that are too long, making it more difficult for general practitioners to navigate.
Risk mitigation	- Education with junior medical staff during orientation about ideal discharge summaries. - Discharge summary to comply with National guidelines for on screen presentation of electronic discharge summaries.[14]

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[14] Australian Commission on Safety and Quality in Health Care - National Guidelines for On-Screen Presentation of Discharge Summaries

BM-014 - Improved surgical throughput

Field	Description
ID	BM-014
Benefit name	Improved surgical throughput
Benefit description	Improve surgical throughput through reducing documentation and more efficient theatre scheduling.
Benefit type	Financial
Benefit classification	Non-cash releasing
Benefit category	Improved productivity
Planned outcomes	• Increased preoperative and surgical efficiency and operating theatre utilisation • Improved patient access to elective surgery.
Rationale	Use of an electronic theatre management system enables hospitals to better plan elective and emergency surgery. This system also enables better identification of inefficiencies.
Benefit baseline	• Utilisation rate: the proportion of time surgery is performed during a planned surgical session. • Length of surgery: the relative length of an operation occurring at different health services. • Unused capacity: the number of theatre hours which an operating theatre is available but not used.
Benefit measure	• Operating theatre unused capacity • Comparative theatre utilisation (the proportion of time patients are in theatre within a scheduled session) • On time starts for the first case • Number of sessions that finish early • Number of sessions that finish late • Preventable hospital initiated elective cancellations on day of surgery • Elective surgery patients treated within the clinically recommended time by category • Average turnaround time between cases.
Calculation	
Target	[x] % reduction in unused operating theatre capacity
Reference literature	Victorian Auditor-General's Office (2017) Victorian Public Hospitals Operating Theatre Efficiency.[15] The Victorian Auditor-General's Office report 'Victorian Public Hospital Operating Theatre Efficiency' argued that Victorian health services are hindered by practices and system features that inhibit productivity gains. Health services can improve their productive efficiency by maximising the time that theatres are available for surgery. This would reduce their average cost of surgery and is likely to reduce elective surgery wait times and waiting lists.
Assumption	• Real-time electronic theatre management system will optimise operating theatre efficiency.

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[15] Victorian Auditor-General's Office, Victorian Public Hospital Operating Theatre Efficiency Oct 2017

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Field	Description
	• The anaesthesia and surgery modules provide all patient information to the clinician before, during and after the perioperative event.
EMR modules required	• Theatre scheduling and surgery, and anaesthesia modules • Clinical notes, a theatre management system and anaesthetic management system.
Potential risk	
Risk mitigation	

BM-015 - Reduced emergency department (ED) length of stay (LOS)

Field	Description
ID	BM-015
Benefit name	Reduced emergency department (ED) length of stay (LOS).
Benefit description	An EMR will reduce delays by allowing the emergency department staff to view the full patient record without having to wait for the paper record to be retrieved. Emergency department clinicians will have access the patient's history at the bedside, thereby improving patient flow.
Benefit type	Financial
Classification	Non-cash releasing
Benefit category	Service improvement
Planned outcomes	Improved information sharing between the emergency department and radiology/pathology and other part of the hospital, reducing the time taken to plan and arrange care.
Rationale	A reduction in ED LOS due to improved patient flow.
Benefit measure	A time in motion study with direct observation of clinicians is required to assess the time spent locating clinical information. • Number of emergency presentations (admitted/non-admitted) • Average emergency length of stay (admitted/non-admitted) • Average cost of an emergency stay per hour (admitted/non-admitted).
Calculation	Number of emergency presentations (admitted)[1] *multiplied by* Average emergency length of stay minutes (admitted)[2] *multiplied by* Target % reduction in emergency length of stay (admitted) [3] *multiplied by* Average cost per emergency department presentation (admitted $969, non-admitted $533)[16] [4] Same calculation for non-admitted except the average cost of emergency stay per hour is substituted with average cost for non-admitted patients. Example calculation for admitted emergency presentation: 41,446[1] x (240)/60[2] * 10%[3] x $969[4] = estimated benefit value.
Target	[x] % reduction in emergency LOS
Reference literature	A study at a Colorado hospital demonstrated the impact of the implementation of electronic ordering on hospital pathology services identified that health services with a fully functional EMR had 22.4% lower emergency LOS than EDs with minimal/no EMR due to reduced time to order and access pathology results.[17] The Royal Children's Hospital report median emergency wait time has decreased by 21.5%.[18]
Assumption	• The introduction of CPOE will decrease turnaround times for pharmacy orders, pathology and diagnostic imaging results • An EMR will allow clinicians to access medical records faster than a paper-based system. • Better information at triage will enable a faster assessment. • Access to electronic clinical guidelines, clinical decision support and improved access to pathology and radiology results will allow for faster assessment of patients.

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[16] National Hospital Cost Data Collection Round 21

[17] Efficiency gains with Computerised Provider Order Entry

[18] HIC Melbourne 2019 – Professor Mike South - Clinical benefits of a Big-Bang EMR implementation RCH EMR Team – Slide 16

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Field	Description
EMR modules required	CPOE and clinical documentation
Potential risk	Wards may not be ready to admit patients from emergency due to bed block, therefore LOS savings may not be fully realised.
Risk mitigation	Optimise EMR clinical workflows to identify opportunities to improve efficiency by streamlining workflows based on clinician feedback.

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BM-016 - Reduced inpatient length of stay (LOS)

Field	Description
ID	BM-016
Benefit name	Reduced inpatient length of stay (LOS)
Benefit description	The use of clinical documentation, clinical pathways and order sets will result in a decrease in avoidable inpatient length of stay.
Benefit type	Financial
Benefit classification	Non-cash releasing
Benefit category	Improved quality and safety
Planned outcomes	Improved bed availability due to a reduction in inpatient length of stay.
Rationale	• Availability of both historical and real-time information about the patient, to support better discharge planning to reduce avoidable bed days. This can be driven by improved productivity and improved access to pathology/radiology results and ordering of medications will contribute to more effective and earlier discharge planning. • Early identification of deteriorating patients achieved by availability of clinical guidance, algorithms and surveillance and early detection of sepsis, and risk of pressure injuries, falls and venous thromboembolism (VTE).
Baseline	Length of stay pre-EMR.
Benefit measure	Length of stay post-EMR.
Calculation	
Target	[x] % reduction
Reference literature	Princess Alexandra Hospital report a reduction in their average inpatient length of stays of 6% and a 38% reduction in the rate of serious falls.[19]
Assumption	
EMR modules required	Clinical documentation, CPOE and clinical decision support
Potential risk	

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[19] Pulse+IT QLD boasts of early win for Digital Hospital ieMR on MARS

BM-017 - Reduction in unplanned re-admissions within 28 days of discharge

Field	Description
ID	BM-017
Benefit name	Reduction in unplanned hospital re-admissions within 28 days.
Benefit description	Increase bed capacity due to a reduction in the number of unplanned readmissions and preventable hospitalisations.
Benefit type	Financial
Benefit classification	Non-cash releasing
Benefit category	Quality and safety
Planned outcomes	A reduction in avoidable unplanned hospital readmissions presenting a capacity and cost-reduction opportunity for the Victorian public health system.
Rationale	An EMR will increase the potential to enhance earlier diagnosis of, and characterisation of disease, with the potential to thereby improve outcomes and reduce avoidable re-admissions. This is expected to also be driven by enhanced medication reconciliation accuracy, legibility and completeness as well as enhanced transfer of information to community care providers.
Benefit baseline	Number of readmissions to acute inpatient hospitals within 28 days of discharge 12 months pre-implementation of the EMR
Benefit measure	Number of readmissions to acute inpatient hospitals within 28 days of discharge 12 months post-implementation of the EMR
Calculation	[1]Number of inpatient episodes per annum multiplied by [2]readmission rate percentage (6.2 per 100 discharges) equals [3]equivalent number of readmissions. Target reduction *multiplied by*[4] Equivalent inpatient episodes[5] (based on targeted % reduction) *multiplied by* Target percentage reduction[6] Equivalent patient episodes[7] Average cost per episode (admitted)[8] = forecast benefit value Example calculation: ([1]98,101 x [2]6.2%) =[3]6,082 [5]6,082 x [6]20% = [7]1216 [7]1216 x [8]$4,459 = $5,422,144 ([8]Independent Hospital Pricing Authority)
Target	[x] % reduction in readmissions within 28 days
Reference literature	Productivity Commission report on Government services - Public Hospitals performance indicator – selected unplanned hospital readmission rates[20]
Assumption	Unplanned hospital readmissions within 28 days of discharge which are avoidable.
EMR modules required	Clinical documentation, CPOE, clinical decision support pathology and imaging modules.
Potential risk	

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[20] Productivity Commission report on Government Services

BM-018 - Improved accuracy of private/compensable patients for billing

Field	Description
ID	BM-018
Benefit name	Improved accuracy of private/compensable patients billing
Benefit description	Improvement in the ability to capture all billable patient care items and consumables for private and compensable patients resulting in more accurate billing. Improved capture of direct patient care and consumables cost (e.g. prosthetics).
Benefit type	Financial
Benefit classification	Cash releasing
Benefit category	Increased Revenue
Planned outcomes	• Improved data to increase revenue collection opportunities based on documented data • EMR will prompt clinicians to document all billable items which will facilitate accurate billing • Reduces the number of Medicare rejections related to 'insufficient information provided. • Improved coding accuracy delivered.
Rationale	When paper records are used, many tasks performed by clinicians are not documented and therefore cannot be billed. The EMR will prompt the clinician to record all procedures performed and some of these will be billable if they are Transport Accident Commission, Department of Veteran Affairs and Work Cover or private insurers.
Benefit baseline	• Average billing per inpatient day pre-EMR • Annual WIES
Benefit measure	• Average billing per inpatient day post-EMR • Annual WIES
Calculation	More accurate capture of information
Target	
Reference literature	The Royal Children's Hospital reported average billing per inpatient day increased by 44% and WIES increased by 13.1%[21]
Assumption	An EMR increases the opportunity of capturing additional procedures that can be charged for including as Emergency, ICU and Surgical. CPOE will capture the pathology, imaging, medications-private and compensable billing.
EMR modules required	Clinical documentation, electronic medication management module, CPOE, Emergency ICU and Surgical Modules
Potential risk	

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[21] HIC Melbourne 2019 – Professor Mike South - Clinical benefits of a Big-Bang EMR implementation RCH EMR Team – Slide 16 Operational/financial

BM-019 - Reduction in clinical coding time

Field	Description
ID	BM-019
Benefit name	Reduction in clinical coding time
Benefit description	Improved access and legibility of clinical information will more accurate clinical coding.
Benefit type	Financial
Benefit classification	Non-cash releasing
Benefit category	Improved productivity
Planned outcomes	Clinical information is in one clinical program increasing accessibility. All clinical information will be recorded electronically to prevent the issue of ineligible handwriting and difficult in locating missing paper records.
Rationale	Access to accurate and legible clinical notes has the potential to reduce the time taken for Health Information Managers to code. In addition, accurate and legible clinical notes are likely to reduce the number of queries to the clinical team.
Benefit baseline	Percentage of inaccurately coded episodes identified as part of clinical coding audits
Benefit measure	An EMR provides appropriate information that captures all the interventions within an episode, which in turn, allows coders to provide the most appropriate clinical code assignments. The impact of correctly identifying changes in Diagnosis Related Groups (DRGs) allows for the identification of potential revenue gains or loss.
Calculation	
Target	
Reference literature	
Assumption	An EMR provides appropriate information that captures all the interventions within an episode, which in turn, allows coders to provide the most appropriate clinical code assignments.
EMR modules required	Clinical documentation
Potential risk	Increased documentation and information in the EMR results in increases in the time clinical coders take to review a record.

Appendix A: Stakeholders engaged

Name	Position	Organisation	Date	Benefit Number
Melina Kung	Clinical Pharmacist	Royal Children's Hospital	11/01/19	BM-004 BM-005 BM-018
Allison Harle	Chief Clinical Information Office	Eastern Health	21/01/19	BM-002 BM-006 BM-009 BM-015
Hamish Rodda	Director, EMR Medical Informatics	Eastern Health		
Carla Read	Health Information Management Advisor	Victorian Agency for Health Information	12/02/19	BM-019
Chris Brown	Manager, Management Reporting Health Systems Reporting	Victorian Agency for Health Information	18/04/19	
Lisa Ciabotti	RCH Improvement Manager Medication Safety	Royal Children's Hospital	14/05/19	BM-004 BM-005 BM-006
Carly Nunn	Clinical Pharmacist		14/05/19	
Wendy Ewing	Quality Use of Medicines Pharmacists	Monash Health	26/06/19	BM-004 BM-005 BM-006
Eileen Hamblin	eHealth Advisor	Digital Health, DHHS	20/06/19	BM-002 BM-004 BM-011 BM-012 BM-013 BM-018
Mona Stead	EMR Project Manager	Eye and Ear Hospital	30/05/19	Framework
Lily Liu	EMR Director	Western Health	02/05/19	Framework
Timothy-Ross Smith	EPMO, Strategy and Design	Business Technology and Information Management Corporate Services, DHHS	11/06/19	Framework
Alison Hardman	Project Manager	Alfred Health	24/07/19	Framework
Trish Aldridge	EMR Project Director	Northern Health	14/08/19	Framework

Name	Position	Organisation	Date	Benefit Number
Matthew Cook	Program Manager Health System Solutions	Systems Solution Unit Business Technology and Information Systems Corporate Services, DHHS	18/09/19	Framework
Bronwyn Taylor	Principal eHealth Advisor, Health Sector Standards and Advisory	Digital Health Health and Wellbeing	14/10/19	Framework
Angela Mannix	Senior Project Officer, Digital Innovation	Safer Care Victoria	14/10/19	BM-001
Belinda MacLeod-Smith	Consumer Lead	Safer Care Victoria	15/10/19	BM-001

Appendix B – References

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