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Data insights to inform new innovative models of care

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Welcome to Country

We'd both like to acknowledge the Traditional Custodians of the land on *which we meet today, the Boon Wurrung and Woiwurrung language groups of the Eastern Kulin Nation who are the custodians of the land and waters, where the Pullman Hotel is situated.*

I would like to acknowledge and pay my respects to their Elders past, present and emerging and the continuing contribution they make to the life of this city and this region.

I would also like to acknowledge and welcome other Aboriginal and Torres Strait Islander people who may be with us today.

About the innovative model of care

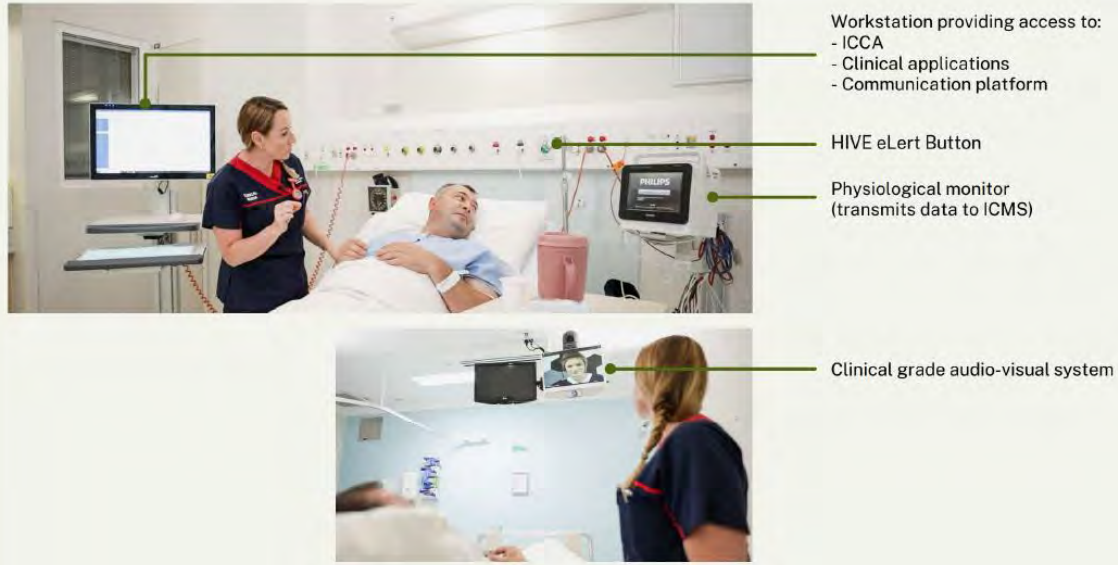
Health in a Virtual Environment (HIVE)

What is the HIVE?

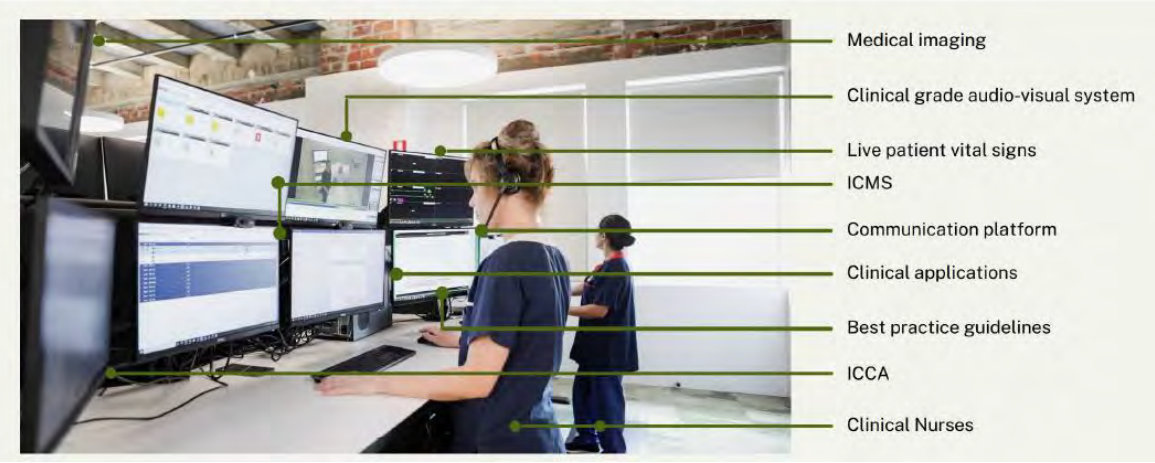
- The East Metropolitan Health Service (EMHS) Health in a Virtual Environment (HIVE) program was a 'first-of-its-kind' virtual health initiative
- 24-hour remote monitoring of medical and surgical inpatients at Royal Perth Hospital (RPH) and Armadale Health Service from the Command Centre based at RPH
- From the Command Centre, dedicated clinicians remotely monitor patients through a clinical platform
- Commenced on 8 December 2020 with the gradual rollout of 50 technology-enhanced bedspaces over the period December 2020 to January 2021
- PFS Consulting were engaged by EMHS to assess HIVE's performance, effectiveness, and impact

HIVE was the winner of the AIM WA Pawsey Supercomputing Centre Innovation Excellence Award 2021

HIVE Bedspace

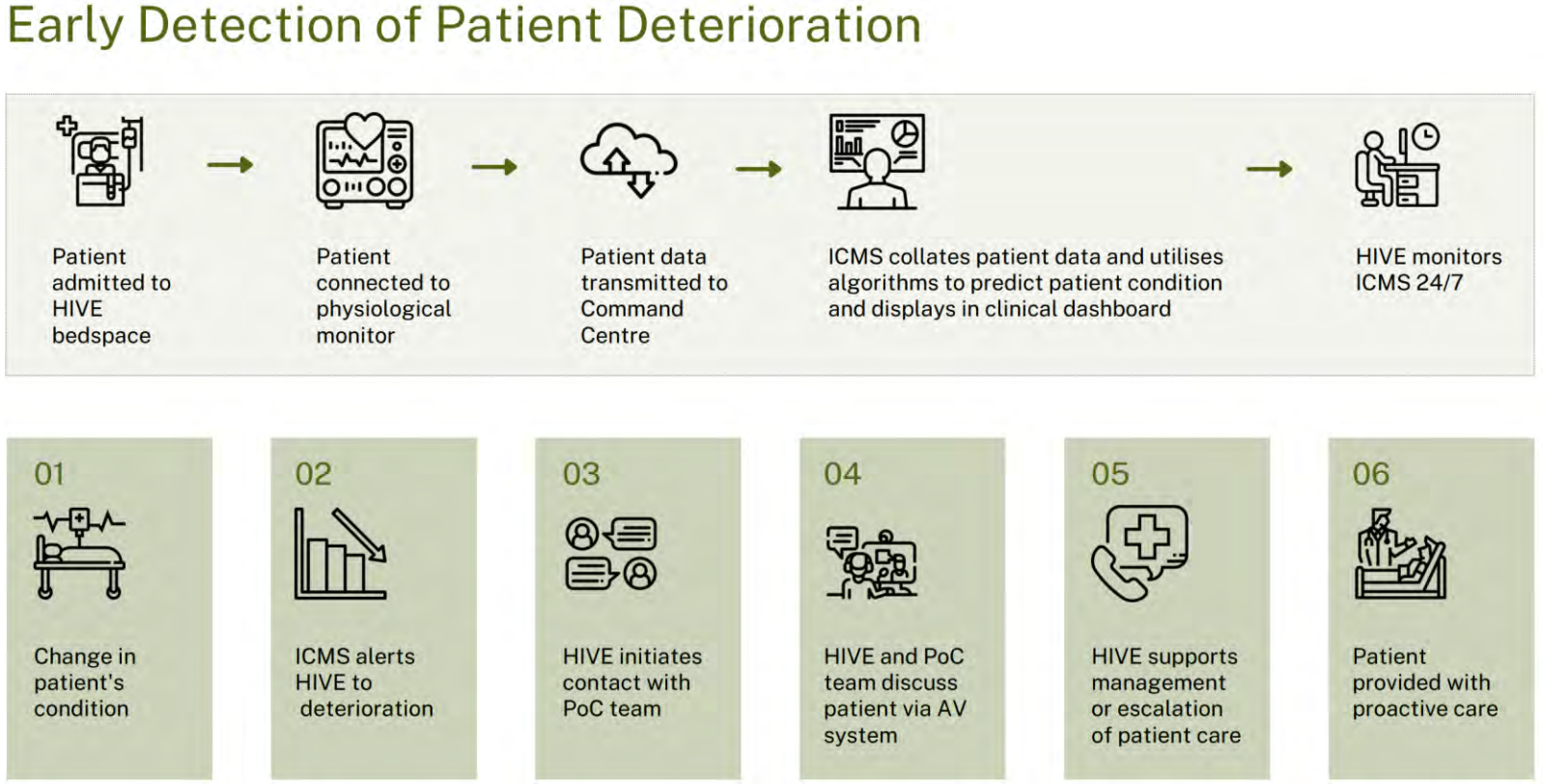


HIVE Workstation

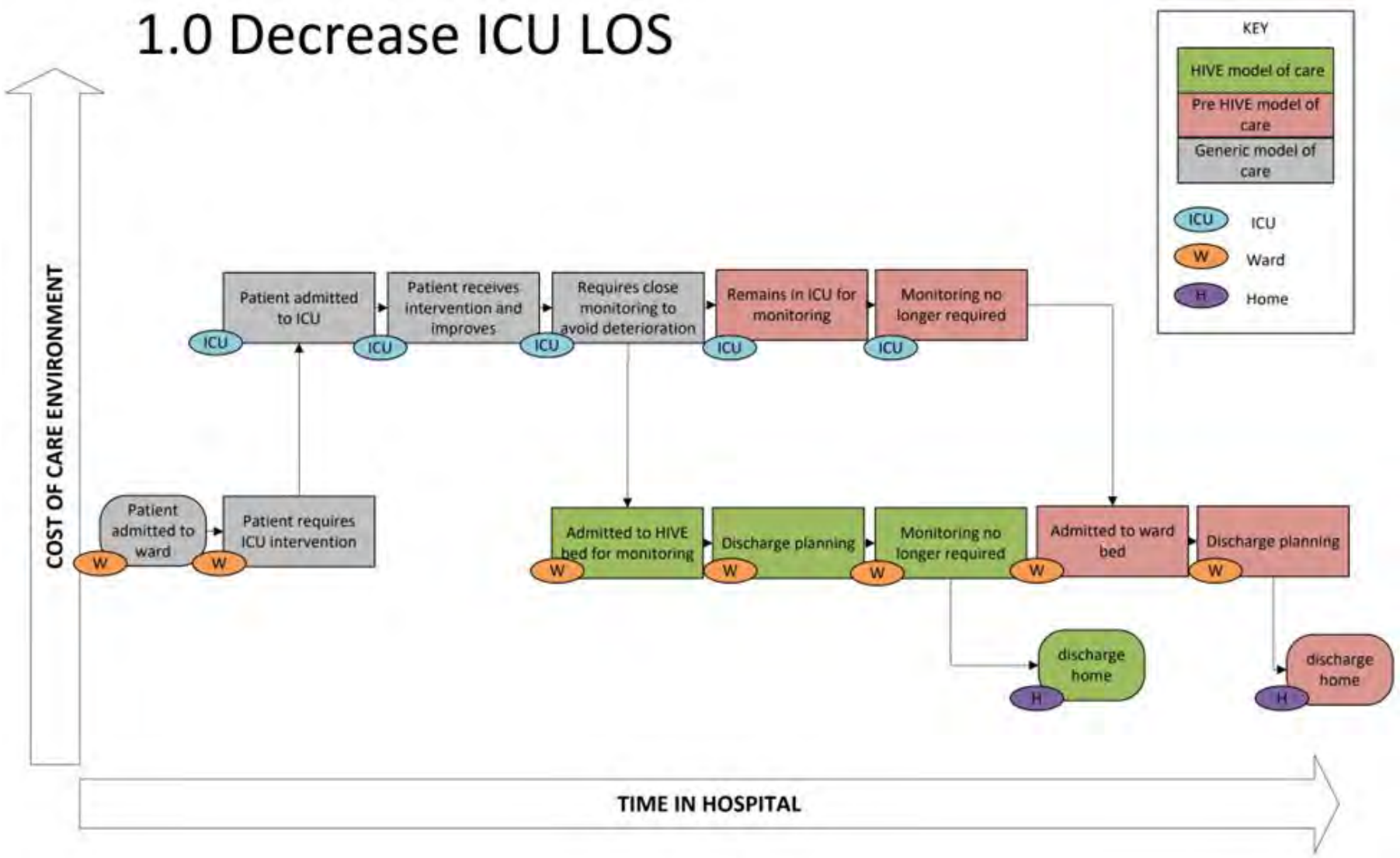


What is the HIVE seeking to achieve?

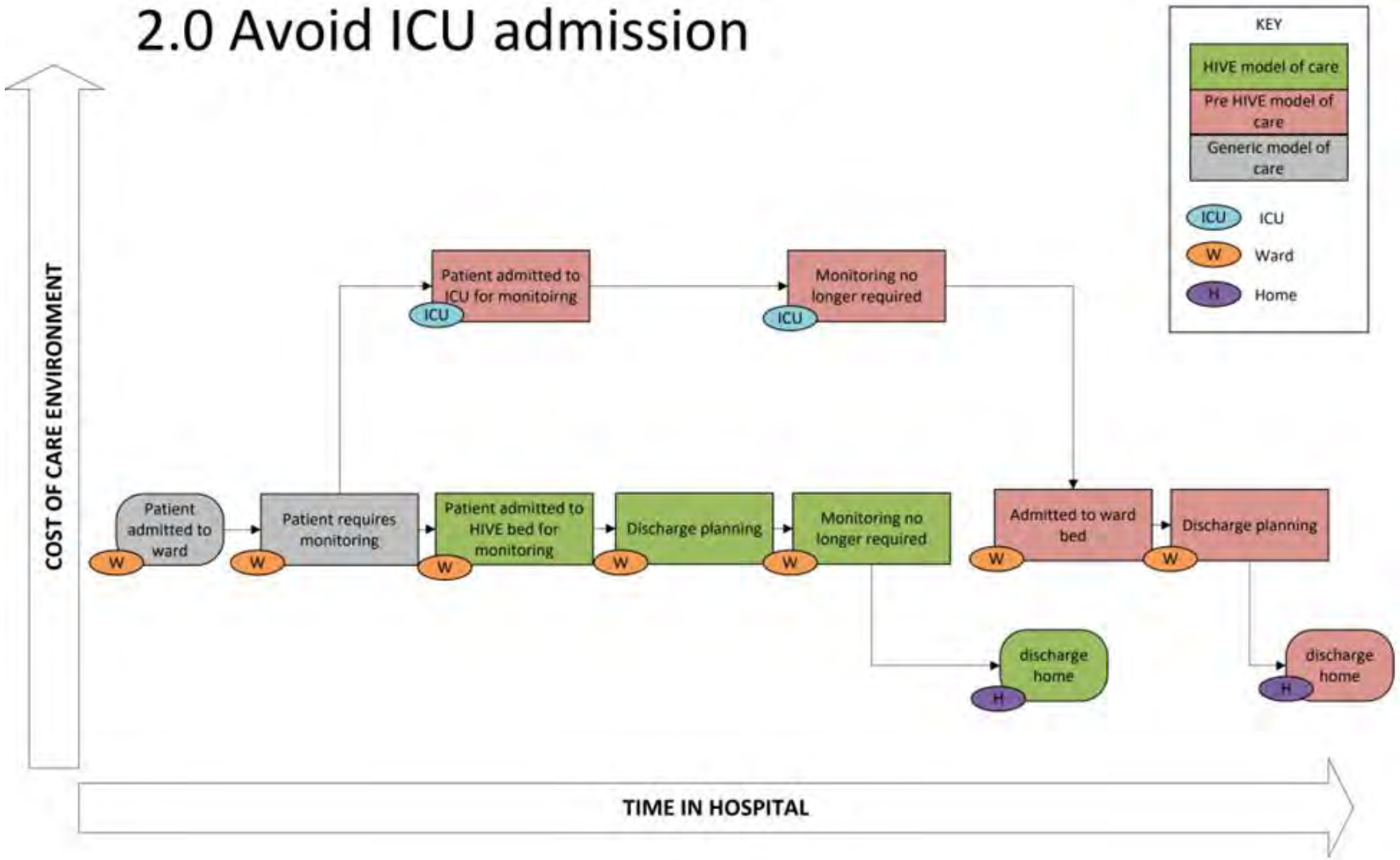
- Broaden telehealth from a clinician/patient contact to a complete Remote Monitoring System (RMS)
- Aid early intervention in patient deterioration
  - reducing length of stay (LOS) and the need for further intensive high-dependency services, such as ICU or High Dependency Unit (HDU) interventions
  - providing the clinician access to richer information to assist in care assessment
  - enabling immediate treatment, improving the quality of care



Potential for better pathways



Potential for better pathways



About the data and analysis objectives

Health Innovation

Background to analysis environment

What makes health and innovation data analysis different?

- Health
  - Specific ethical and privacy issues
  - Speed of data collection
  - Complexity of data (usually sourced from multiple systems)

- Innovation
  - Need to develop hypotheses to test against
  - Need to create a control group as a baseline
  - Datasets in the intervention group are likely to be small
  - Need to be prepared for the data to not be supportive to the hypotheses ⇨ learn and pivot

The targets - HIVE

- Objective 1 – Block funding
  - Estimate the cost of running HIVE between 2022-23 and 2025-26
  - Liaise with health practitioners and quantify the benefits of HIVE
  - Draft a business case explaining the benefits of HIVE qualitatively as well as quantitatively
- Objective 2 – Activity based funding (ABF)
  - Assist in exploring different approaches that could be adopted to attract Commonwealth funding beyond the block funded period in Objective 1
  - Perform high level National Weighted Activity Unit (NWAU) calculations to explore the feasibility of an ABF model
  - Lag time and ABF calculation model limitations
- Objective 3 – Innovative model of care
  - Develop a submission under the Innovative Model of Care provisions of the National Health Reform Agreement
  - Adopt most of the quantitative findings from Objective 1 and 2 to improve outcomes
  - Quantify, measure and assess model of care innovation

Analysis approach

- Data
  - Provided with large de-identified datasets including unique patient numbers
  - Used to collate patients' information from different databases and allow a comprehensive understanding of the patients' journey
- Control group
  - An appropriate control group was developed (i.e. of non-HIVE patients) to compare the impact of the HIVE during its pilot period
    - Needed to be quantifiable and intuitive
    - Required extensive dialogue between actuaries, clinicians and HIVE management
  - Assessed HIVE against an estimate of the Conditional Expected Value of a non-HIVE group normalised for COVID-19
  - Some outlier patients excluded from both data sets in a consistent manner
  - By July 2021, there were ~1,000 HIVE episodes
- Analysis being updated in 2022 as datasets grow and statistical significance of findings improves

Did data support the hypotheses?
Length of Stay (LOS)

DRG	DRG short descriptions	Expected HIVE Admissions p.a. at 40% utilisation rate	Expected (Decrease) / Increase in ICU LOS as a result of HIVE at 40% utilisation rate
E41A	RESP SYS DIS,NON-INV VENT, MAJC	20	(34)
I06Z	SPINAL FUSION FOR DEFORMITY	19	97
W01A	VENT/TRACH/CRA INTERVTN FOR MT, MAJC	10	(1,623)
H01B	PANCREAS,LIVER&SHUNT INTERVTN, INTC	9	(177)
A14B	VENTILATION >=96&<336HRS, INTC	16	(624)
G02A	MJR SMALL&LARGE BOWEL INTERVTN, MAJC	15	(456)
F08A	MJR RECNSTR VASC INTERVTN-PUMP, MAJC	13	(266)
G01A	RECTAL RESECTION, MAJC	7	(672)
A14C	VENTILATION >=96&<336HRS, MINC	6	(519)
A14A	VENTILATION >=96&<336HRS, MAJC	9	216
B03A	SPINAL INTERVTN, MAJC	7	(74)
A13A	VENTILATION >=336HRS, MAJC	20	(9,452)
	ALL OTHER DRGS	237	(955)
	TOTAL	**388**	**(14,539)**

- Evidence of reduced LOS with HIVE intervention across most DRG's and in aggregate

Once a patient has been stabilised in ICU, in many cases their need for this intensive care is not essential, however constant monitoring is required, and prior to HIVE, this meant some ICU patients were not deemed ward ready.

With the advent of HIVE, these patients can be transferred out of ICU earlier than would otherwise have been the case and be treated in a more appropriate bed type.

With the active patient monitoring in HIVE, this provides the necessary care, and in a ward environment that is more appropriate for the ongoing treatment of the patient's condition.

Did data support the hypotheses?
Cost of Stay (COS)

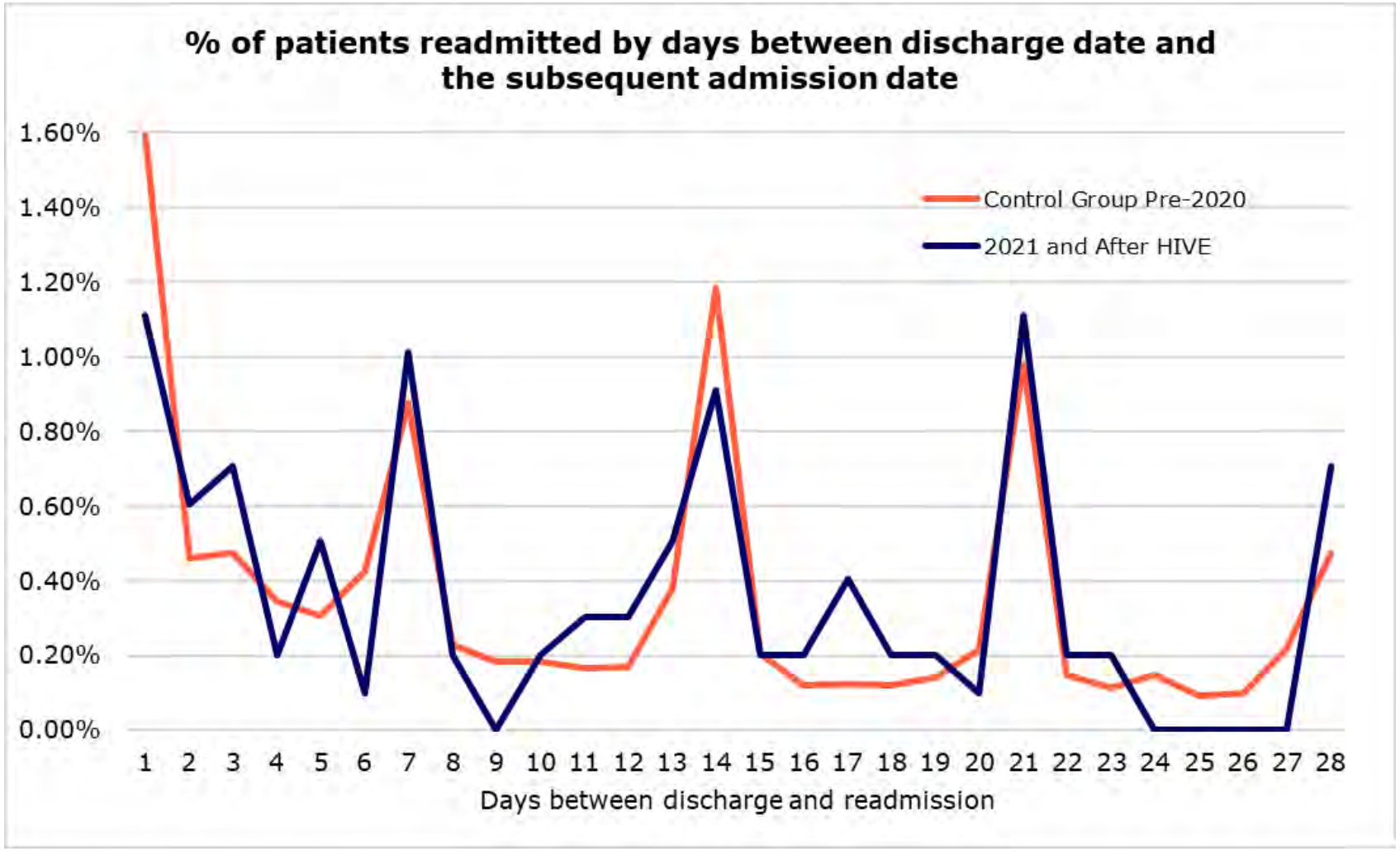
DRG	DRG short descriptions	Expected HIVE Admissions p.a. at 40% utilisation rate	Expected (Decrease) / Increase in Hos COS* as a result of HIVE at 40% utilisation rate
E41A	RESP SYS DIS,NON-INV VENT, MAJC	20	($276,996)
I06Z	SPINAL FUSION FOR DEFORMITY	19	$43,650
W01A	VENT/TRACH/CRA INTERVTN FOR MT, MAJC	10	($690,945)
H01B	PANCREAS,LIVER&SHUNT INTERVTN, INTC	9	($44,272)
A14B	VENTILATION >=96&<336HRS, INTC	16	($279,664)
G02A	MJR SMALL&LARGE BOWEL INTERVTN, MAJC	15	($292,442)
F08A	MJR RECNSTR VASC INTERVTN-PUMP, MAJC	13	$85,155
G01A	RECTAL RESECTION, MAJC	7	($279,531)
A14C	VENTILATION >=96&<336HRS, MINC	6	($183,561)
A14A	VENTILATION >=96&<336HRS, MAJC	9	($330,309)
B03A	SPINAL INTERVTN, MAJC	7	$49,086
A13A	VENTILATION >=336HRS, MAJC	20	($3,447,634)
	ALL OTHER DRGS	237	$211,108
	TOTAL	**388**	**($5,436,354)**

- Evidence of reduced COS with HIVE intervention across most DRG's and in aggregate

Higher complexity patients (designated by the A, B or C classification for the last letter of the four-character DRG code) for certain DRGs benefit most from having a HIVE episode during their hospital stay, in conjunction with their ICU episode.

As with the LOS analysis, the COS savings could be further optimised utilising the empirical data as part of clinical review and analysis to determine the diagnoses where patient recovery is most improved with a HIVE episode as part of their hospital stay.

Did the data support the hypothesis?
Readmissions



Overall readmission rate: (i.e., summing the line):

- **Control group: 10.19%**
  (8,328 / 81,682 admissions)
  - MDC 17 Neoplastic: 4.1%
  - MDC 11 Kidney and Urinary Tract: 1.0%
  - MDC 05 Circulatory System: 0.7%
- **HIVE: 10.21%**
  (101 / 989 admissions)
  - MDC 17 Neoplastic: 2.5%
  - MDC 11 Kidney and Urinary Tract: 1.3%
  - MDC 04 Respiratory System: 1.1%
- HIVE readmission rate consistent with Control Group, and opportunity to improve based on assessing diagnoses that respond most positively to a HIVE episode of care during a hospital admission.

Readmissions: After excluding 1 day admission & compared against control group

Benefits discovered

• Earlier detection of clinical deterioration in hospital patients	➡ Number and type of early interventions for in scope wards/areas
• Improved clinical outcomes for patients requiring a high level of observation	➡ Reduction in hospital readmission rate
• Earlier patient transfer from ICU to ward	➡ Reduction in ICU length of stay; Reduction in hospital LOS
• System efficiencies	➡ Decrease in nurse special utilisation on wards with HIVE bedspaces
• Cost-of-stay	➡ Increased activity and throughput
	➡ Lower overall cost of hospital admission with a HIVE bed stay

Independent external expert analysis is a key feature of the funding submission

Overall the funding case has been strongly supported by the data but a number of our findings point to the potential for system optimisation

Key themes and ongoing analyses

Data Analysis around Innovation

Evidence-based program optimisation

Assessment of performance, effectiveness, and impact

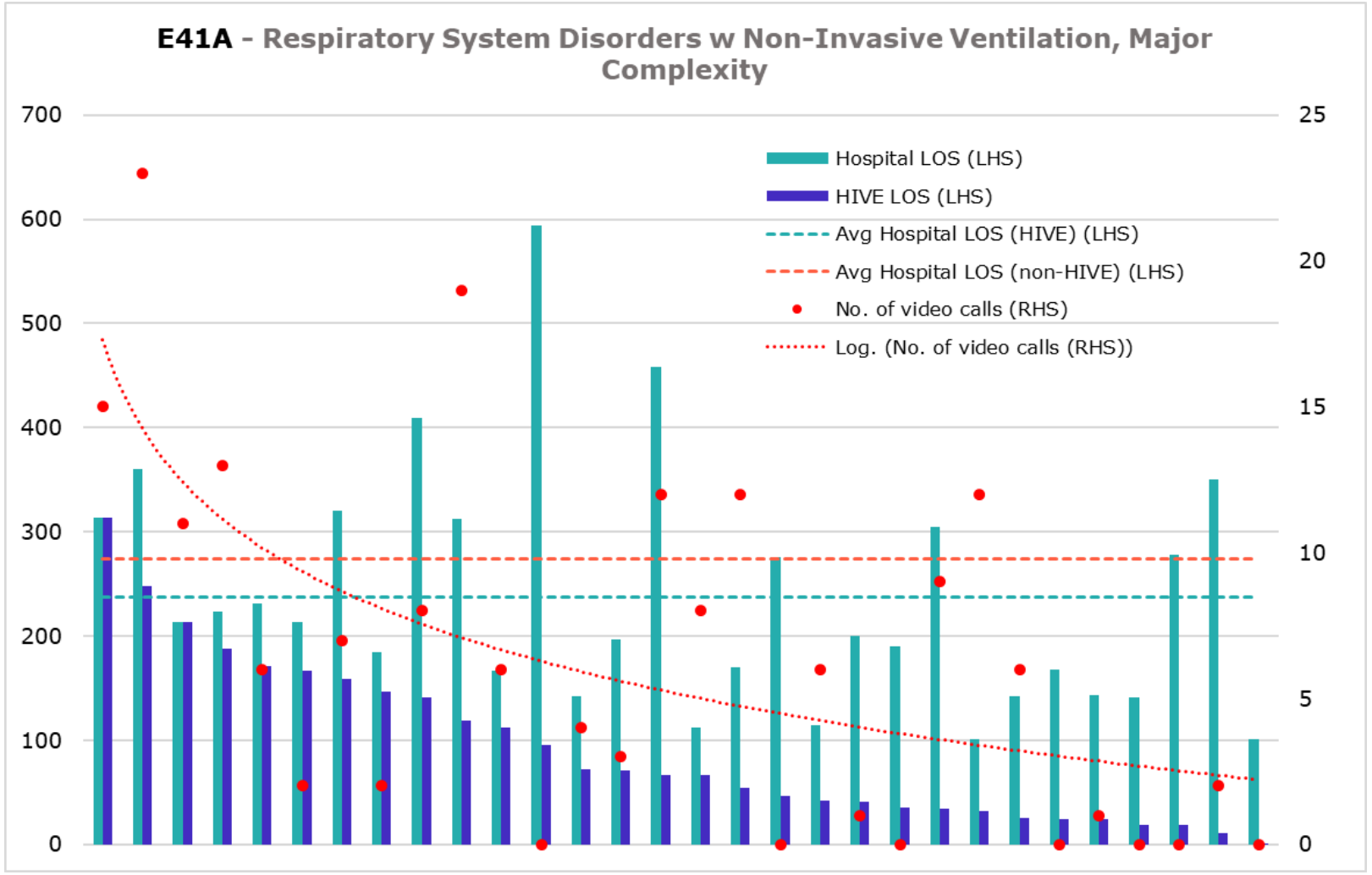
- Hospital and patient admission analysis

Chart combination of

- Hospital LOS and HIVE LOS, by admission and average
- HIVE video calls by admission, and log

For this example, DRG E41A

- Details a lower average LOS with HIVE episode and E-lerts identified for each patient admission

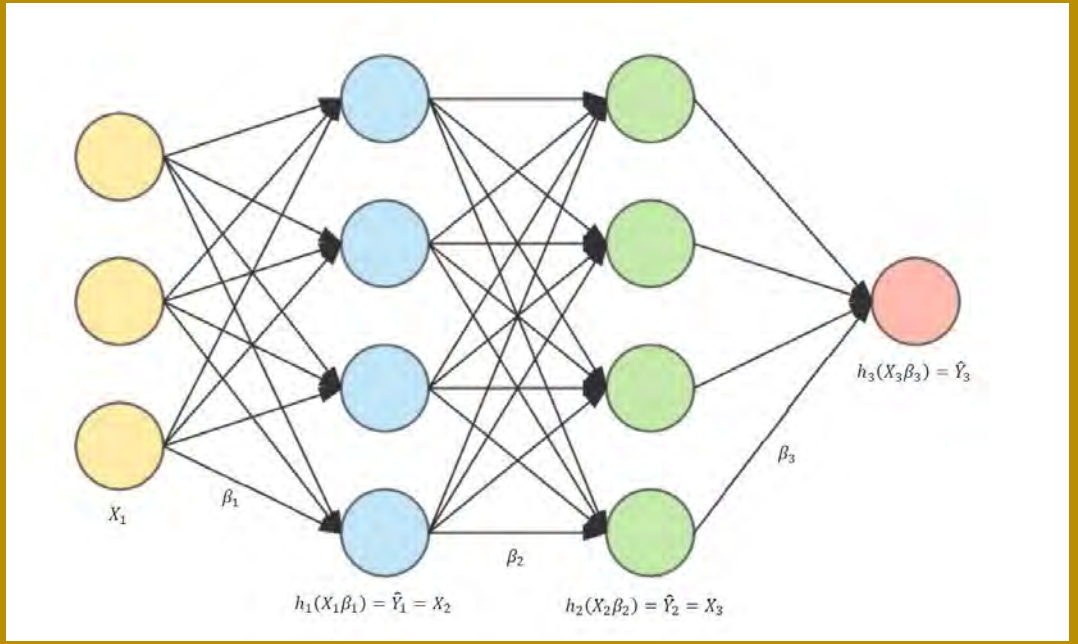


Evidence-based program optimisation

- Decision optimisation
  - Using data to review eligibility, hypothesis creation and testing
  - Neural networks to inform decisions on:
    - When to admit
    - When to exit/transition
    - Bed monitoring
  - Pre-curser methodologies to Machine learning and AI
- Predictive analysis
  - To support clinical decision making around utilisation of alternative forms of treatment
  - Machine learning from clinical decision histories and outcomes

What is a neural network?

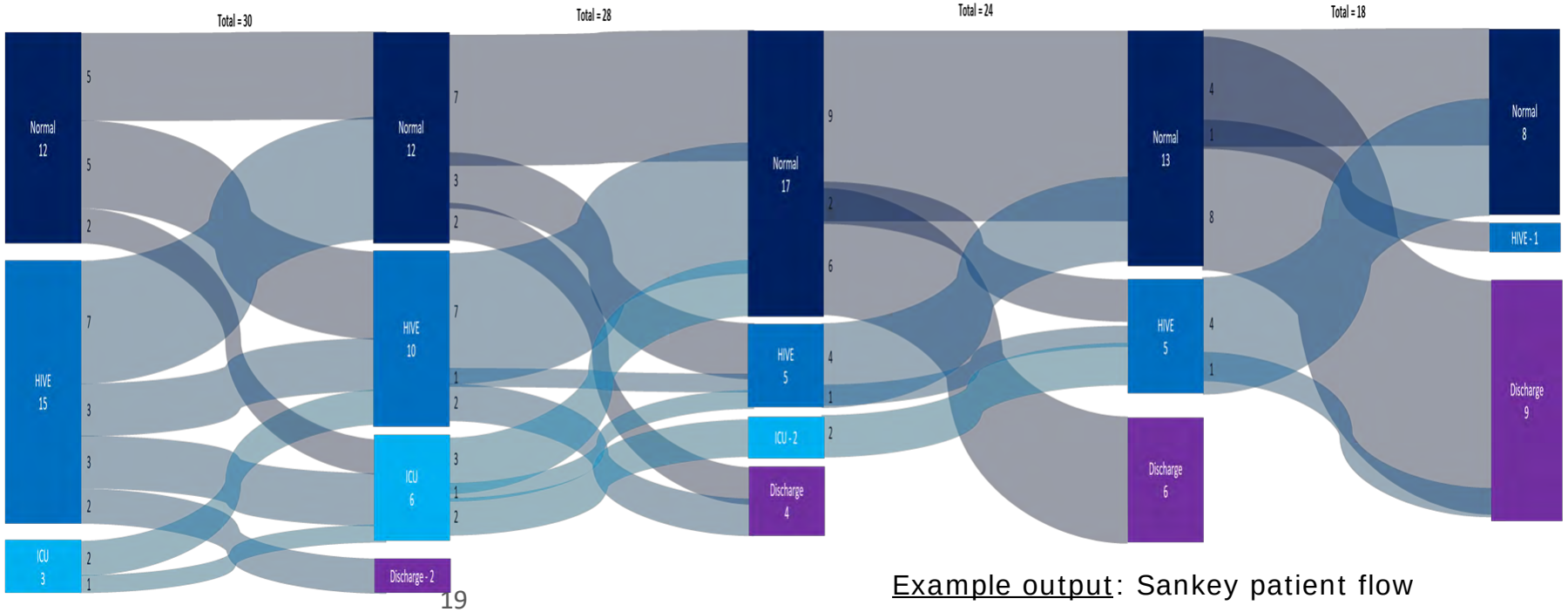
Data 'input' layer | Algorithm **'hidden' layer(s)** | Decision **'output' layer**



Generally parameterised using a canonical GLM

Evidence-based program optimisation

- Patient Profiling - Could allow better historical context to the patient situation; Incorporate ethical and privacy considerations
- Reporting, understanding & planning ⇨ especially in unexpected or problem areas:
  - Many of these are common to other areas of actuarial practice
  - Managing cyclicality of demand and supply of services, particularly important in Hospitals and Health care environments
  - Planning for surges and catastrophes
  - Understanding funding cross-subsidies and the issues they create



Example output: Sankey patient flow

Questions?

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