Developing an algorithm to identify opportunities for bundled payment in Singapore

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SingHealth
Defining Tomorrow's Medicine

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Background

As Singapore healthcare system increasingly adopts value-based care approach, new funding models (e.g., bundled payments) have been piloted and introduced in several health clusters in the country.

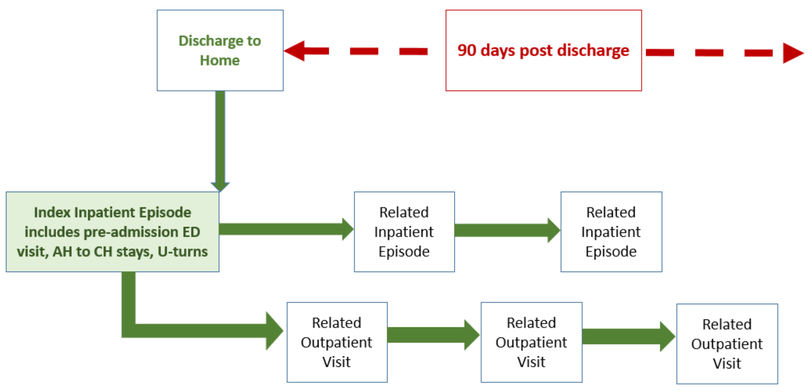
An **algorithm** was developed for SingHealth to **capture episodes of care associated with an initial acute care episode**. These episodes form bundles that **comprise post-discharge outpatient visits, community hospital admission and readmission episodes**. An automated process to **capture clinical and financial information across the entire care bundle** has also been developed.

Ensuring quality of clinical outcomes are aligned with the streamlining of bundled framework

Establishing a comprehensive, one-for-all platform to integrate data across care settings and providers

Methodology

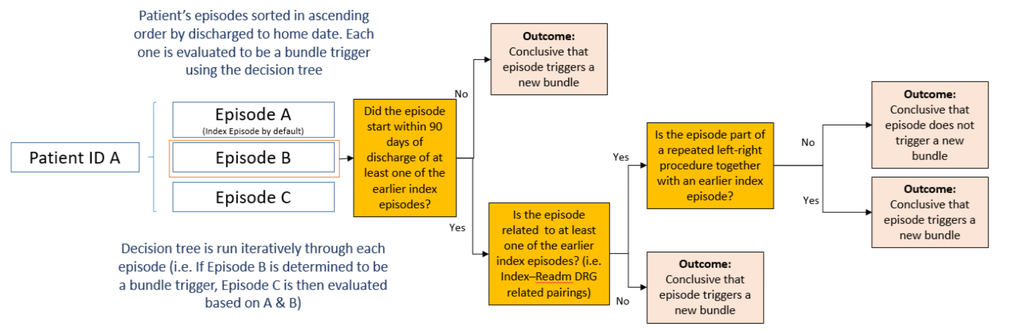
A Bundle: Consists of the **index episode** and **any subsequent re-admissions and post-discharge Specialist Outpatient Clinic (SOC) care** related to the index episode that **occurs within 90 days (of discharge from the index episode)**.



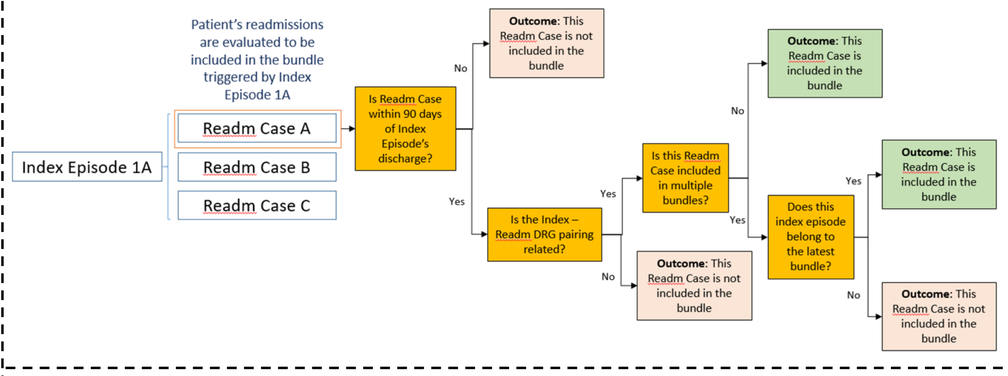
Permutations of a potential index cases

1) Admit to AH and discharge to home
2) Admit to ED and then to AH and discharge to home
3) Admit to ED and then to AH, discharge to CH and then to home
4) Admit to AH, discharge to CH and then to home

Phase 1: Identifying the Index Episodes based on the Unique Patient Identifier (ID)

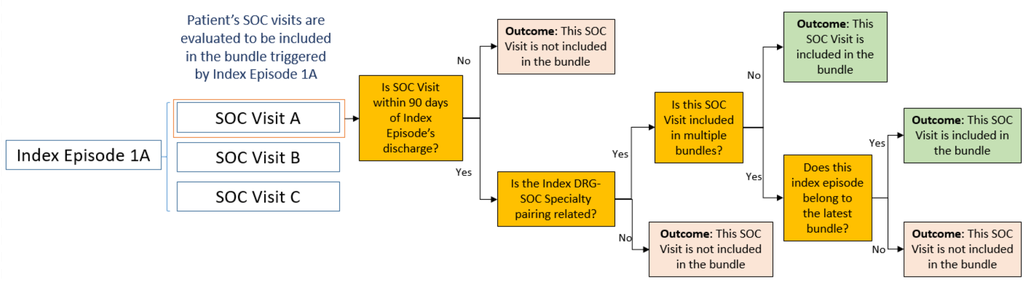


Phase 2: Linking Related Readmissions to Index Episodes (includes pre-admission ED visit and post-discharge to CH)



Phase 3: Linking Related SOC visits to Index Episodes

All SOC visits in AHs and SCs according to Patient ID sieved out, and ranked based on their visit dates.



After the completion of all three phases, each bundle was formed by stringing together and arranging all readmissions, CH transfers and SOC visits in ascending order by their start date.

Cost Variance Analysis

- Assess average bundle cost
- Identify outliers

Results

The algorithm was used to tag cases across various settings and institutions into their respective bundles. The result from the output bundles was then **visualized using a business intelligence (BI) dashboard** to enable the **derivation of insights** through the analysis of trends and variations **across patient routes and DRGs**.

Dashboard Overview

Overall Summary	• No of Bundles by Institution & Index Admit Year • No of Bundles with different care setting • Comparison of Index DRG Complexities between different Institutions • Cost Incurred in each care setting (e.g. AH, CH, SOC & A&E) by Quarter • Top 5 General Patient Routes
Institution Summary	• No of Bundles by MDC & Index Admit Year • Median Bundle Cost vs No of Bundles • All General Patient Routes
Case Drilldown by Cost	• No of Bundles by Index DRG • Cost of Incurred in each care setting (e.g. AH, CH, SOC & A&E) by Quarter • Case Details
Length of Stay	• LOS Statistics by Index Admit Year • Top 5 DRG with highest LOS • LOS Trend by Quarter • Case Details
Overview by DRG & Institution	• Total Cost/Gross Bill/Theoretical Subvention by DRG & Institution • Toggle between Total Cost/Gross Bill/Theoretical Subvention

Generate actionable insights for upper management

Clinical perspective

	DRG Code	Description of DRG	No of Bundles	% Share	Avg. Index LOS	Median Bundle Cost	Bundle Cost
2b	G67B	Oesophagitis and Gastroenteritis W/O Cat/Sev CC	2,400	10.7%	1.8	$1,388	$3,631,905
	D61Z	Dysequilibrium	1,489	6.7%	2.3	$1,944	$3,184,642
3a	E62A	Respiratory Infections/Inflammations W Catastrophic CC	959	4.3%	10.0	$7,145	$7,974,950
3b	E62B	Respiratory Infections/Inflammations W Severe or Moderate CC	891	4.0%	5.9	$4,259	$4,739,647
	L41Z	Cystourethroscopy, Sameday	709	3.2%	1.3	$1,088	$895,746
	B77Z	Headache	694	3.1%	2.1	$1,853	$1,426,564
2a	G67A	Oesophagitis and Gastroenteritis W Cat/Sev CC	636	2.8%	5.1	$3,427	$2,501,755
	I68B	Non-surgical Spinal Disorders W/O CC	607	2.7%	4.6	$2,826	$2,054,917
	E69B	Bronchitis and Asthma W/O CC	559	2.5%	2.1	$1,703	$971,113
	K60B	Diabetes W/O Catastrophic or Severe CC	523	2.3%	3.3	$2,552	$1,758,714

*Top 10 Index DRGs with Highest **Volume** (figures are for illustrative purpose only)*

Potential area for improvement

1. DRG E62A – 3rd largest volume, high median LOS & bundle cost
2. Oesophagitis and Gastroenteritis – Both DRG G67A (2a) & G67B (2b)
3. Respiratory Infections/Inflammations – DRG E62A (3a) & E62B (3b)

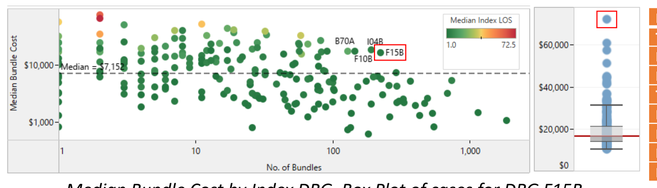
Financial perspective

DRG Code	Description of DRG	No of Bundles	% Share	Avg. Index LOS	Median Bundle Cost	Bundle Cost
E62A	Respiratory Infections/Inflammations W Catastrophic CC	959	4.3%	10.0	$7,145	$7,974,950
F15B	Interventional Coronary Procs W/O AMI W Stent Implantation W/O Cat or Sev CC	289	1.3%	3.1	$18,304	$5,595,563
I04B	Knee Replacement W/O Catastrophic or Severe CC	248	1.1%	12.6	$24,271	$5,313,314
E62B	Respiratory Infections/Inflammations W Severe or Moderate CC	891	4.0%	5.9	$4,259	$4,739,647
B70A	Stroke and Other Cerebrovascular Disorders W Catastrophic CC	168	0.8%	40.8	$23,078	$3,960,094
F10B	Interventional Coronary Procedures W AMI W/O Catastrophic CC	189	0.8%	4.0	$22,918	$3,902,439
G02A	Major Small and Large Bowel Procedures W Catastrophic CC	107	0.5%	29.9	$35,217	$3,892,178
G67B	Oesophagitis and Gastroenteritis W/O Cat/Sev CC	2,400	10.7%	1.8	$1,388	$3,631,905
D61Z	Dysequilibrium	1,489	6.7%	2.3	$1,944	$3,184,642
I68A	Non-surgical Spinal Disorders W CC	382	1.7%	13.0	$5,617	$3,127,552

*Top 10 Index DRGs with Highest **Bundle Cost** (figures are for illustrative purpose only)*

Potential area for improvement

5 DRGs:
F15B
I04B
B70A
F10B
G02A
(with median bundle cost above $10,000)



Median Bundle Cost by Index DRG, Box Plot of cases for DRG F15B

Index Case No	8176E
Total Bundle Cost	$78,550
Doctor Code	GR5269
Index LOS	16
Total LOS (days)	18
No of Readm	2
No of SOC	1
Index Case DRG	F15B
Patient Route	ED - AH - CH - (READM) - (READM) – SOC

Case level analysis

For outlier case 8176E: Each of the readmissions costs ≥ $20,000 for each 1 day stay (Finance team to highlight these outlier cases to clinical leads → identify and improve on potential clinical loopholes)

Case Type	ED	AH	CH	(READM)	(READM)	SOC
Case No	2234Y	8176E	5029G	8100J	8121I	3891F
Total Cost	$250	$25,000	$8,000	$22,000	$23,000	$300
LOS	NA	1	15	1	1	NA

Case level details for outlier of DRG F15B

Conclusion

The algorithm and Dashboard allows the health system to manage complex data in the bundled payment framework and to evaluate alternative care models.

- ✓ Integrate large variety of data sources to form the care bundles associated with the patients' journey
- ✓ Improves value with better patient experience, clinical quality and health outcomes
- ✓ Lowers costs of care with elimination of wastages

Future work will be to implement the generic methodology to other care bundles for continuous quality improvement to achieve the vision of value-based health care