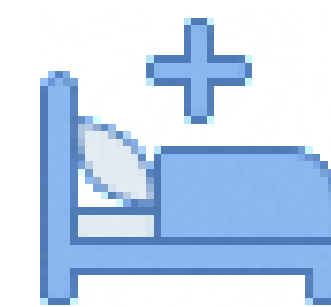




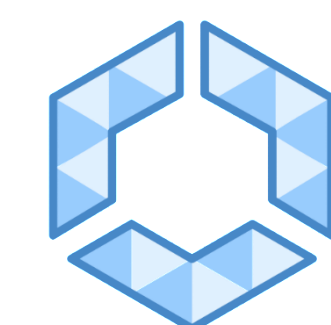
## Background

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.



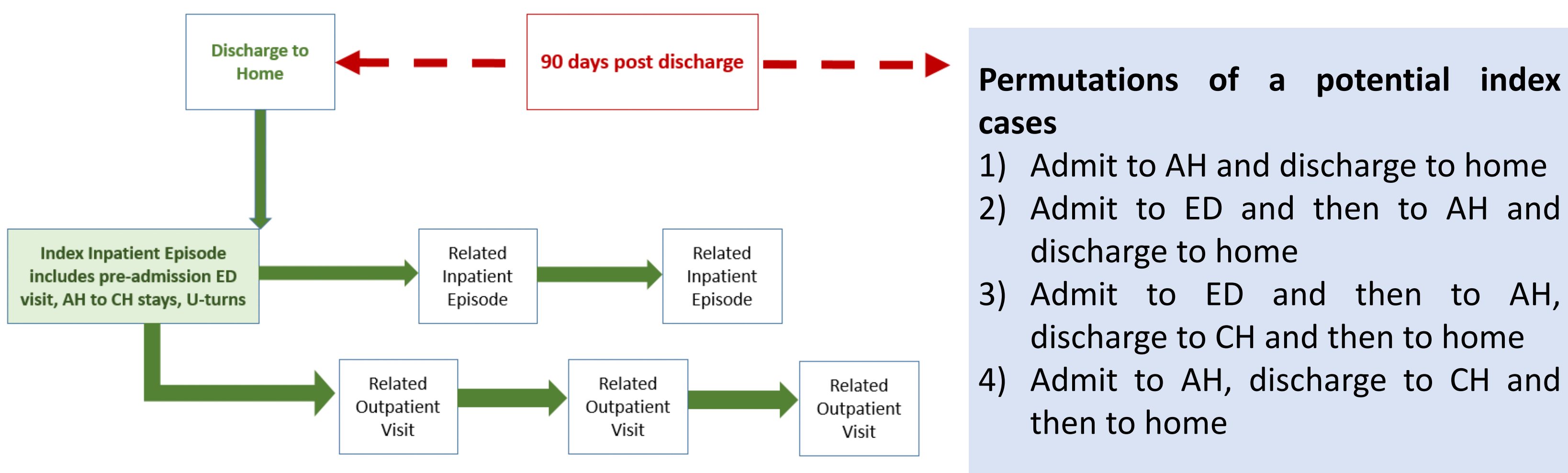
Ensuring quality of clinical outcomes are aligned with the streamlining of bundled framework



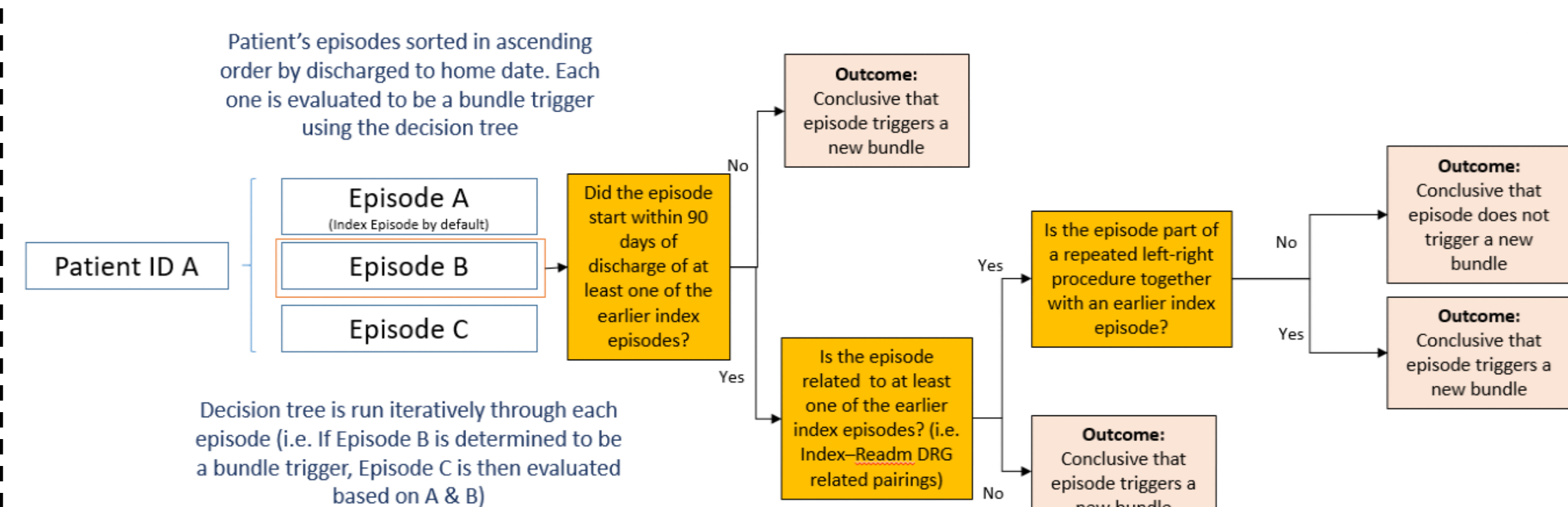
Establishing a comprehensive, one-for-all platform to integrate data across care settings and providers

## Methodology

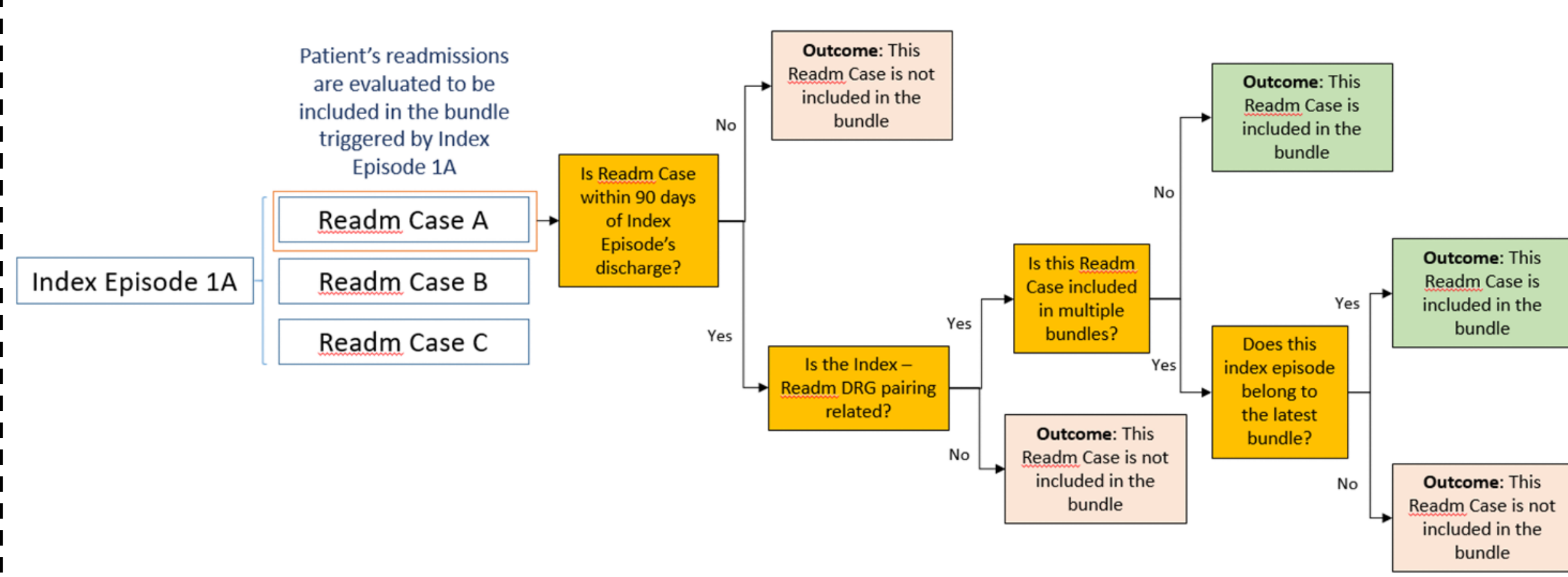
**A Bundle:** Consists of the index episode and any subsequent re-admissions and post-discharge Specialist Outpatient Clinic (SOC) care related to the index episode that occurs within 90 days (of discharge from the index episode).



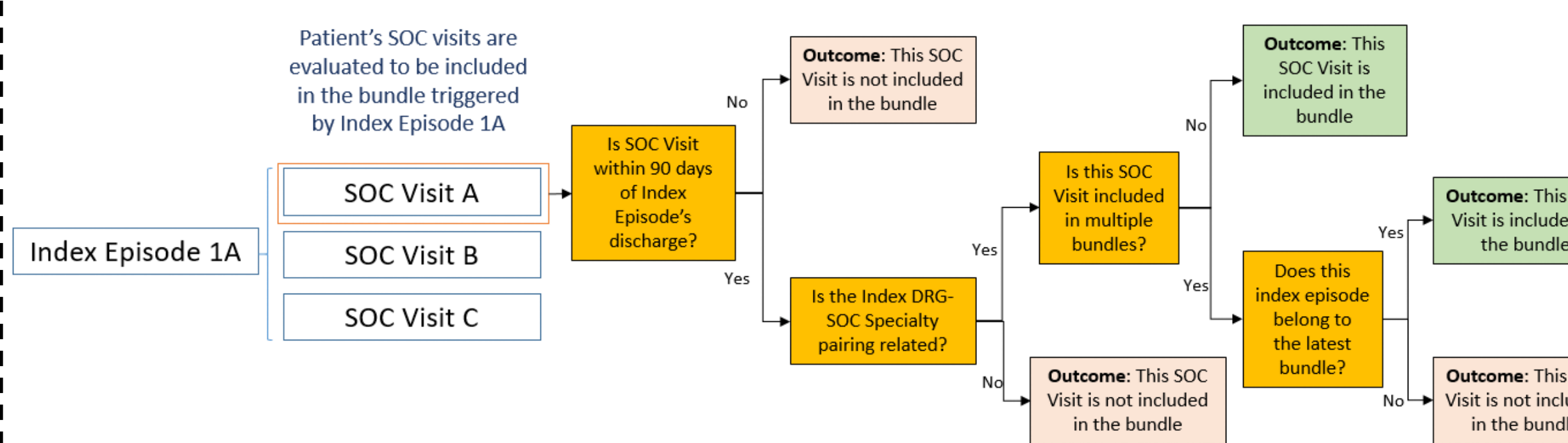
### Phase 1: Identifying the Index Episodes based on the Unique Patient Identifier (ID)



### 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



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	Dyscequilibrium	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, Same-day	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

#### Potential area for improvement

1. DRG E62A – 3<sup>rd</sup> 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)

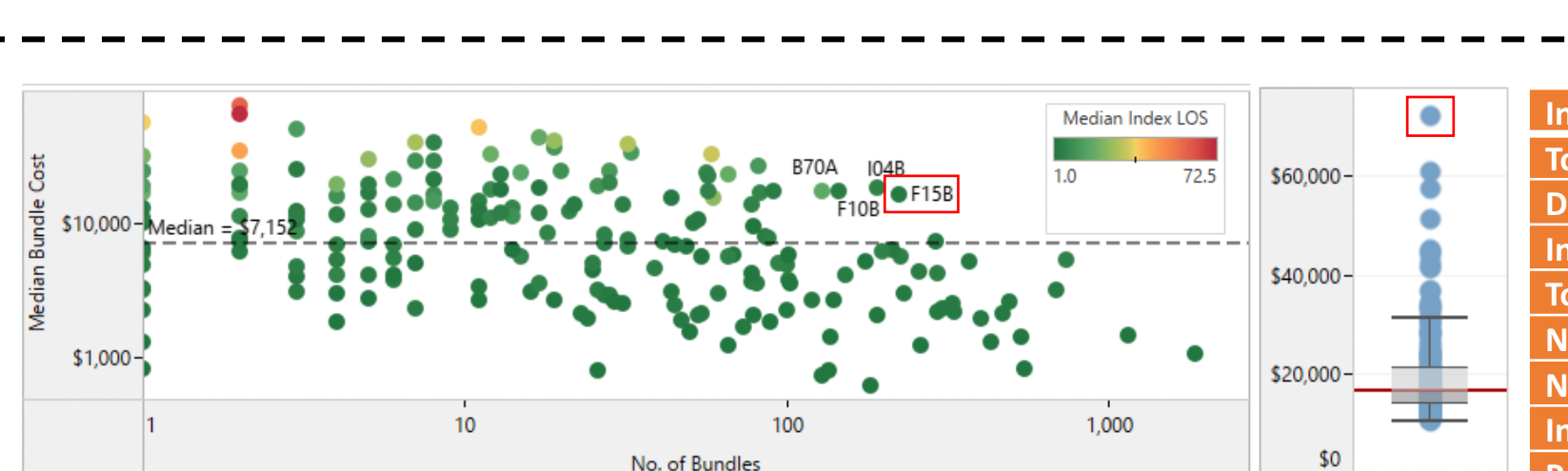
#### Top 10 Index DRGs with Highest Volume (figures are for illustrative purpose only)

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	Dyscequilibrium	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

#### Potential area for improvement

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

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



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  $\geq$  \$20,000 for each 1 day stay (Finance team to highlight these outlier cases to clinical leads  $\rightarrow$  identify and improve on potential clinical loopholes)

Case Type	ED	AH	CH	(READM)	(READM)	SOC
Case No	2234Y	8176E	S029G	8100M	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