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## **Multimedia Appendix**

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## 1 Multimedia Appendix 1

### 1.1 Appendix A: HIMSS Analytics Maturity Assessment Model (AMAM) Stages

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Stage	Name	Description	Key Capabilities
Stage 0	Data Collection	Basic data capture without integration	Manual data entry, paper records
Stage 1	Data Verification	Automated data validation and error checking	Basic quality controls, automated checks
Stage 2	Data Utilization	Standard reporting and basic analytics	Automated reports, dashboard creation
Stage 3	Automated Decision Support	Rule-based clinical and operational support	Clinical alerts, automated protocols
Stage 4	Population Health Analytics	Population-level analysis and intervention	Cohort identification, risk stratification
Stage 5	Predictive Analytics	Statistical modeling and predictive capabilities	Predictive models, trend analysis
Stage 6	Cognitive Analytics	Machine learning and AI integration	Advanced AI, pattern recognition

Stage	Name	Description	Key Capabilities
Stage 7	Precision Medicine	Personalized treatment and genomic integration	Personalized care, genomic analytics

## 1.2 Appendix B: Healthcare NL2SQL Query Examples

### 1.2.1 Patient Population Analysis

**Natural Language:** “Show me all diabetic patients over 65 who had an HbA1c test in the last 6 months”

**Rationale:** Aligned with NCQA HEDIS measures for Comprehensive Diabetes Care (CDC), monitoring HbA1c testing compliance in older adult populations.

**Generated SQL:**

```

1  SELECT p.patient_id, p.age, l.test_date, l.result_value
2  FROM patients p
3  JOIN lab_results l ON p.patient_id = l.patient_id
4  JOIN diagnoses d ON p.patient_id = d.patient_id
5  WHERE d.icd10_code LIKE 'E11%' -- Type 2 Diabetes
6    AND p.age > 65
7    AND l.test_name = 'HbA1c'
8    AND l.test_date >= DATE_SUB(CURRENT_DATE, INTERVAL 6 MONTH)

```

### 1.2.2 Complex Clinical Cohort: Heart Failure Readmission Risk

**Natural Language:** “Identify patients discharged with Heart Failure in 2024 who had a readmission within 30 days, excluding those discharged to hospice. For each, calculate their max creatinine levels during the index stay.”

**Rationale:** Supports CMS Hospital Readmissions Reduction Program (HRRP) tracking by identifying 30-day all-cause readmissions for Heart Failure (HF) index stays, with standard exclusions (hospice).

**Generated SQL:**

```

1  WITH IndexAdmissions AS (
2      -- Identify index admissions for Heart Failure
3      SELECT
4          a.admission_id,
5          a.patient_id,
6          a.discharge_date,
7          a.discharge_disposition
8      FROM admissions a
9      JOIN diagnoses d ON a.admission_id = d.admission_id
10     WHERE d.icd10_code LIKE 'I50%'           -- Heart Failure codes
11        AND a.discharge_date BETWEEN '2024-01-01' AND '2024-12-31'
12        AND a.discharge_disposition != 'HOSPICE' -- Exclusion Criteria
13  ),
14  Readmissions AS (
15      -- Find readmissions within 30 days
16      SELECT
17          i.patient_id,
18          i.admission_id AS index_admission_id,
19          r.admission_date AS readmission_date,
20          DATEDIFF(r.admission_date, i.discharge_date) AS days_to_readmit
21      FROM IndexAdmissions i
22      JOIN admissions r ON i.patient_id = r.patient_id
23      WHERE r.admission_date > i.discharge_date
24          AND r.admission_date <= DATE_ADD(i.discharge_date, INTERVAL 30 DAY)
25  )
26  -- Final Output: Cohort with Max Creatinine
27  SELECT
28      r.patient_id,
29      r.index_admission_id,
30      r.days_to_readmit,
31      MAX(CASE
32          WHEN l.unit = 'mg/dL' THEN l.val_num
33          WHEN l.unit = 'mmol/L' THEN l.val_num / 88.4    -- Value
34              Normalization
35          ELSE NULL
36      END) as max_creatinine_mgdl
37  FROM Readmissions r
38  JOIN lab_events l ON r.index_admission_id = l.admission_id
39  WHERE l.itemid IN (50912, 50913) -- Creatinine lab codes
40  GROUP BY r.patient_id, r.index_admission_id, r.days_to_readmit;

```

### 1.2.3 Quality Metrics

**Natural Language:** “How many patients were readmitted within 30 days of discharge for heart failure?”

**Rationale:** Aligned with CMS Hospital Readmissions Reduction Program (HRRP) requirements, demonstrating aggregation capabilities for organizational quality reporting by specifically tracking 30-day readmission rates for heart failure populations.

**Generated SQL:**

```
1 SELECT COUNT(DISTINCT r.patient_id) as readmission_count
2 FROM (
3   SELECT a1.patient_id, a1.discharge_date, a2.admission_date
4   FROM admissions a1
5   JOIN admissions a2 ON a1.patient_id = a2.patient_id
6   JOIN diagnoses d ON a2.admission_id = d.admission_id
7   WHERE d.icd10_code LIKE 'I50%' -- Heart failure
8     AND a2.admission_date BETWEEN a1.discharge_date AND DATE_ADD(a1.
9       discharge_date, INTERVAL 30 DAY)
10    AND a1.admission_id != a2.admission_id
11  ) r
```