Multimedia Appendix

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1 Multimedia Appendix 1

1.1 Appendix A: HIMSS Analytics Maturity Assessment Model (AMAM) Stages (1)

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
               Normalization
34         ELSE NULL
35     END) as max_creatinine_mgdl
36 FROM Readmissions r
37 JOIN lab_events l ON r.index_admission_id = l.admission_id
38 WHERE l.itemid IN (50912, 50913) -- Creatinine lab codes
39 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: Demonstrates aggregation capabilities for organizational quality reporting, 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.
          discharge_date, INTERVAL 30 DAY)
 9      AND a1.admission_id != a2.admission_id
10  ) r
```

1.   Analytics H. Analytics maturity assessment model (AMAM) global report. Healthcare Information and Management Systems Society [Internet]. HIMSS Analytics; 2024. Available from: https://www.himss.org/maturity-models/amam/