Running decision support logic retrospectively to determine guideline adherence: a case study with diabetes

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Introduction

Requiring additional clinicians' input in a new decision support system (DSS) is often a major implementation obstacle. Another limitation is the process of fine tuning the exact logic of the new DSS, which is often done in the production environment. Our approach was to utilize only currently available Electronic Health Record data (EHR), not requiring any additional data entry by clinicians. The main objective of this study is to demonstrate the use of an analytical suite called RetroGuide (RG) [1-5]. RG provides an environment for beta testing of potential decision support logic using only retrospective data and assessing its impact.

Methods

- Intermountain Healthcare's Enterprise Data Warehouse (EDW) is used as the source of EHR data (only terminology-coded data, no free text).
- Analyzed patients: From primary care diabetes data mart, insured via affiliated health plan, death certificate present (1846 patients). At least two manually recorded blood pressure measurements 11 months apart and 2 years after diabetes diagnosis (194 patients).
- RetroGuide analytical suite:
  1. *data extraction phase:* assembly of chronologically ordered coded EHR event data for each cohort patient from various sources.
  2. *scenario modeling phase:* creation of graphical executable model representing analytical steps. Scenario flowchart layer mimics a manual chart review process. Modeling constructs include use of nodes with links to external applications (code layer) and ability to use conditions on flowchart transition arrows.
  3. *execution phase:* sequential execution of the scenario on each cohort patient, creation of output reports
  4. *reports review phase:* hierarchy of linked reports showing execution of the modeled scenario on real EHR data

Results

SUMMARY REPORT: dm8 SIZE: 194 detailed report time (hrs):0.37496918 max_limit:50000

#	NODE NAME			PATIENTS (satisfy/eligible/total)	RATE (%)
010	(CSC) (m01) (AGE1) DM control hospitalization (ICD Dg) anywhere [jump 2 years]		jump 2 years	194 / 194	100.0
011	(v01) Blood pressure, systolic (BPS)		jump 11 months	194 / 194	100.0
012	(v02) Blood pressure, systolic (BPS)			194 / 194	100.0
017	sBP decreased			92 / 194	47.42268
018_1	both v01 and v02 over 130	H02		78 / 194	40.206184
018_2	both v01 and v02 over 140			31 / 194	15.979381
018_3	v01 was over 130 but v02 is under 130	achieved control		32 / 194	16.494844
018_3	v01 was under 130 but v02 is over 130	controlled became uncontrolled		31 / 194	15.979381

Fig.2: Summary (population) report

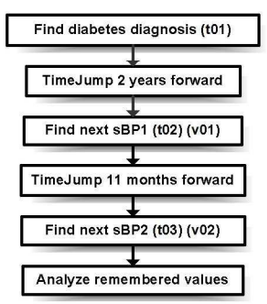

Fig.3: Modeled RG scenario: flowchart layer (simplified)

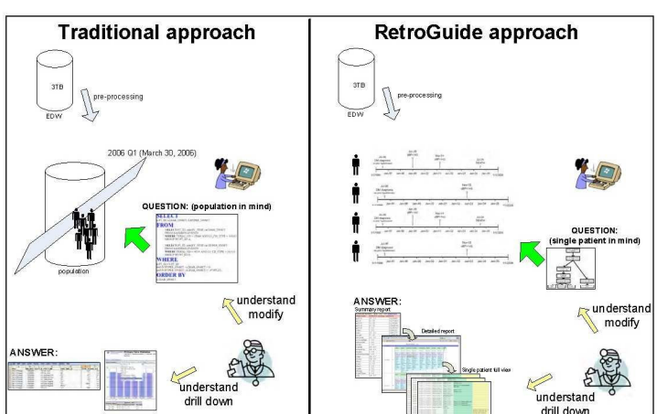

Fig.1: Comparison of the traditional vs. RetroGuide analytical approaches

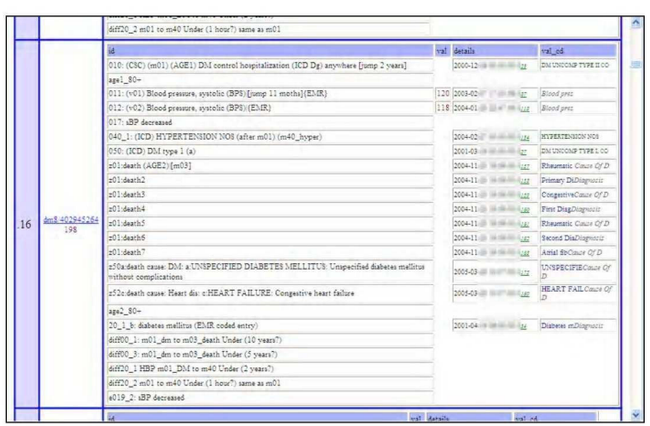

Fig.4: Detailed (execution trace) report

1. DataGet applications	2. Analytical applications	
• Find_Diagnosis	• Jump_Forward_X_Months	• Remember_Timestamp
• Find_Lab	• Jump_to_First_EHR_Event	• Remember_Numeric_Value
• Find_Medication	• Jump_to_Last_EHR_Event	• Evaluate_Two_Timestamp_Difference_Criterion
• Find_Exam	• Jump_to_Timestamp	• Track_Patient_Count
• Find_Coded_Value_under_Exam	• Get_Pt_Age_at_Current_Position	• Generate_Custom_Pt_List
• Find_Coded_EHR_Event	• Patient is Male	• Capture_Statistical_Data_Item

Fig.5: List of selected RG external applications which can be used inside flowchart nodes (parameters not shown)

Conclusion

With RetroGuide, we were able to model and execute a scenario which operates on the individual patient level and tracks blood pressure control over time. RG splits the traditional code-only representation format into two distinct layers - graphical flowchart layer and hidden code layer (Figure 5).

416	2004-01-	Standard Lab Data	Protime INR	Coagulation Tissue Factor Induced, Platelet Poor Plasma Patient Quantitative Coagulation	Higher Tha...	26.4
417	2004-01-	Standard Lab Data	Protime INR	Coagulation Tissue Factor Induced INR, Quantitative, Coagulation		2.4
418	2004-01-	Clinical Text Data	Lab Annotation			
419	2004-01-	Pat Obs Event	Standard Vital Signs Panel	Blood pressure, systolic (BPS),		118
420	2004-01-	Pat Obs Event	Standard Vital Signs Panel	Blood pressure, diastolic (BPD),		60
421	2004-01-	Clinical Text Data	CAC Progress Note			
422	2004-01-				MITRAL VALVE DISORDER	6

Fig.6: Individual patient view (chronologically ordered EHR coded events)

Discussion

In contrast with a comparable study investigating blood pressure control in diabetics [6] our methodology enables easy integration of additional temporal restrictions on the considered blood pressure values or other events of interest. Additional advantages of RetroGuide when compared to traditional SQL-based database tools for retrospective data analysis are:

- a user-friendly flowchart model as a shared logic formalism between the data analyst and clinicians (Figure 1 and 3)
- ability to use variables and constructs like "time jump" and "current EHR position"; procedural modeling approach resembling manual chart review process
- support for extensive "drill-down" capability into available EHR data via a hierarchy of customizable reports: detailed execution trace report (Figure 4) and individual patient view (Figure 6).
- single-patient execution model

References

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Acknowledgement: Author would like to thank Roberto Rocha, Peter Haug, EDW team and Intermountain for their support.

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