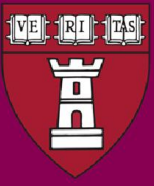




# Heterogeneity and Intensity of Documentation of Lifestyle Counseling and Glycemic Control in Patients with Diabetes



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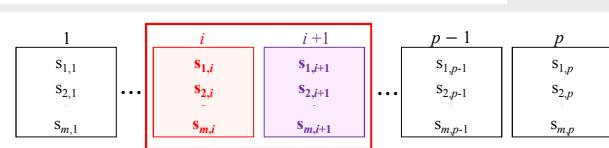
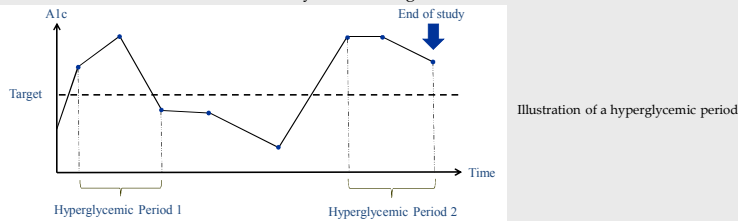
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## Introduction

- Most studies on Electronic Medical Record (EMR) use and quality of care have focused on structured EMR documentation.
- Very little is known about how characteristics of narrative EMR documentation reflect the quality of care delivered to the patient.
- We evaluated the relationship between quantitative characteristics of narrative EMR documentation of lifestyle counseling and blood glucose control in patients with diabetes.

## Materials & Methods

- Design: Retrospective cohort study of 10,870 adult patients with diabetes followed for at least 2 years at primary care practices affiliated with two academic medical centers between 2000 and 2010.
- Previously validated<sup>1</sup> natural language processing (NLP) system was used to abstract sentences documenting lifestyle counseling from narrative provider notes.
- We developed metrics of narrative EMR documentation: 1. *Documentation heterogeneity*; 2. *Documentation intensity*.
- Unit of analysis: *Hyperglycemic period* – a single period of continuous hemoglobin A1c > target
- Outcome variable: Time to A1c <7.0% = length of the hyperglycemic period
- Confounder variables: age, gender, ethnicity, primary language, income, insurance type, insulin treatment, obesity during the period, Charlson comorbidity index, rate of A1c measurements, rate of medication intensification, rate of lifestyle counseling, initial A1c level



Hyperglycemic period contains notes 1, ..., p documenting lifestyle counseling.

Note *i* contains sentences 1, ..., *m* documenting lifestyle counseling.

**Documentation heterogeneity**  
• calculated for two consecutive notes with documented lifestyle counseling as the Levenshtein distance<sup>2</sup> between the relevant sentences, normalized by the length of the longer sentence

$$\frac{1}{p-1} \sum_{i=1}^{p-1} \text{MAX}_{1 \leq j \leq m} \left[ L\{S_{j,i}, S_{j,i+1}\} \right]$$

$$\left[ L\{S_{j,i}, S_{j,i+1}\} \right]_{1 \leq j \leq m} = \begin{pmatrix} L\{S_{1,i}, S_{1,i+1}\} & \dots & L\{S_{1,i}, S_{m,i+1}\} \\ L\{S_{2,i}, S_{1,i+1}\} & \dots & L\{S_{2,i}, S_{m,i+1}\} \\ \dots & \dots & \dots \\ L\{S_{m,i}, S_{1,i+1}\} & \dots & L\{S_{m,i}, S_{m,i+1}\} \end{pmatrix}$$

L: Normalized Levenshtein distance between two sentences

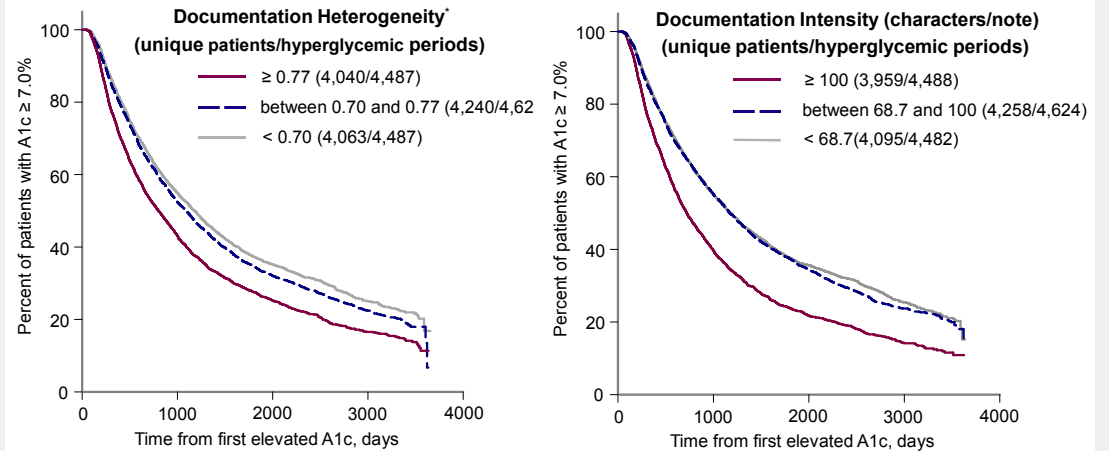
**Documentation intensity**  
• the mean number of characters per note dedicated to documenting lifestyle counseling

$$\frac{1}{p} \sum_{i=1}^p \left[ \sum_{j=1}^m \{ \text{LEN}(S_{j,i}) \} \right]$$

LEN: a function to evaluate the sentence length in number of characters

## Results

- 13,594 hyperglycemic periods were included in the analysis.
- The NLP software identified 183,611 sentences from 92,671 provider notes.



Documentation heterogeneity*	Median time to A1c control
≥0.77	26 months
between 0.71 and 0.77	36 months
<0.71	39 months

Documentation intensity†	Median time to A1c control
≥100	24 months
between 68.7 and 100	38 months
<68.7	39 months

Kaplan-Meier curves were plotted for tertiles by documentation heterogeneity and intensity. *P* < 0.0001 by log-rank test for all. \*Normalized Levenshtein distance. †Number of characters per note.

## Effects of documentation characteristics on time to A1c control

Variable	Hazard ratio	P value (χ <sup>2</sup> )
Documentation heterogeneity*	1.680	< 0.0001
Documentation intensity (100 characters/note)	1.698	< 0.0001

Multivariable analysis adjusted for patient and treatment characteristics. \*Normalized Levenshtein distance.

## Conclusions

- Both higher documentation heterogeneity and higher documentation intensity of lifestyle counseling are associated with faster achievement of A1c control.
- Heterogeneity and intensity of documentation of lifestyle counseling in narrative provider notes may be used as indicators of quality of diabetes care.

## Acknowledgements and literature cited

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- 1. Turchin A, Goldberg SI, Breydo E, Shubina M, Einbinder JS. Copy/paste documentation of lifestyle counseling and glycemic control in patients with diabetes: True to form? *Arch Intern Med.* 2011;171(15):1393-1394.
- 2. Levenshtein V. Binary codes capable of correcting deletions, insertions, and reversals. *Soviet Physics Doklady.* 1966(10):707.