

### Algorithm for Real-Time Identification of Blood Pressure Data Entry Errors Using Longitudinal Data From the Electronic Health Records

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**Background/Aims:** Data from electronic health records (EHR) are prone to error due to collection methods or human entry. However, historical measures can be used to validate subsequent measures. Real-time algorithms can be created that utilize longitudinal data to identify and require confirmation of questionable data during the patient encounter. **Methods:** We developed algorithms for identifying potential errors in the Geisinger Health System EHR. These were developed with two key principals in mind: (1) the algorithms should be relatively simple to program and implement, and (2) the identification of erroneous values should depend, to varying degrees, on both a patient's historical data and on data from the overall population. The more encounters the patient has had in the past, the more heavily the outlier cutoff values should depend on that patient's historical data. The algorithms were tested and refined on a sample of over 2 million systolic blood pressures from over 212,000 individuals. **Results:** The selected algorithm utilized prior measurements in the EHR and allowed for the possibility that the stability of the measurements might vary across subjects (e.g., the standard deviation might vary with the mean). The properties of the algorithm are described and are used to identify cutoffs for defining 5%, 1%, and 0.1% of the measurements as questionable data. Future studies are planned to test the usefulness of the algorithm in real time. In addition, these studies can be used to identify a cutoff threshold that results in an appropriate balance between flagging too many accurate values, and not flagging enough inaccurate values. **Conclusions:** An algorithm that uses historical blood pressure data can be used to identify potential errors during the patient encounter. The relatively simple algorithm does not require complex programming/software and likely can be tailored to optimize use by clinicians. The implementation of such an approach has the potential to improve the quality of EHR data.

### Applications of Mediation Analysis in Behavioral Medicine Research

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**Background:** In a typical regression model, the total effect of an independent variable (e.g., social support or strain) on a dependent variable (e.g., health status) is estimated. In mediation analysis, a regression model accounts for the possibility that the total effect consists of a direct effect and an effect mediated through a third variable (e.g., patient activation). We examined the potential mediating effects of patient activation between various psychosocial circumstances and health status, dietary intake, exercise, and obesity among a sample of adults in a group-model managed care organization (MCO). **Methods:** A mixed-mode survey (written and Internet options) was administered from October through December 2005 to 5309 MCO enrollees, 25-59 years of age, who were randomly sampled from 3 condition cohorts: (1) adults with type 2 diabetes, (2) adults with elevated lipids but no acute CVD history, and (3) adults with no major morbidities (low risk). The survey included previously validated measures of psychosocial circumstances that measured support or strain between patients and physicians (care delivery climate), among friends and family members (social climate), and among coworkers (work climate); patient activation (PAM-13); healthy behaviors (e.g., exercise, dietary intake); and physical and emotional health (SF-12). Using the approach of Baron and Kenney, linear and logistic regression models were estimated to compute the mediating effect of patient activation. The mediating effect was tested for significance using the Sobel test. **Results:** Twenty-two hundred twenty-four completed the survey (42% response rate). Forty-five percent of respondents were black; 60% were female. Adjusted for condition cohort and other patient covariates,

psychosocial circumstances tended to have significant ( $P < 0.05$ ) total and direct effects on health status (better with more supportive climates), diet and exercise (better with more supportive climates) and BMI (lower with more supportive climates). Patient activation was a significant mediator (Sobel  $P < 0.05$ ) of the observed relationships between psychosocial circumstances and each of the three outcomes (health status, health behavior, and BMI) for all cohorts. **Conclusions:** Patient activation has an important mediating role between psychosocial circumstances and health and healthy behaviors, particularly with respect to social climate.

### Evidence-Based Medicine Integrator (EBMI): A New Simulation Architecture for Chronic Disease

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**Background:** Computer simulation models are increasingly used in complex chronic disease to prioritize treatments, study the effects of treatments, and guide policy and management. The accuracy of these models is doubtful, particularly in real-world use. **Methods:** We designed EBMI to 'think' as an evidence-based clinician thinks, by combining the best user-specified trial evidence about treatment effectiveness with the best possible individualized estimates of patient risk. Local validity is much more likely because EBMI's risk functions can be estimated from local data. The use of local data also allows the model to be used for real-time clinical prioritization in local settings. **Results:** EBMI reproduces Kaiser Permanente Northwest data very closely and, in its only validation to date against a clinical trial, closely replicated the Heart Protection Study. More validations and studies using the model are underway. **Conclusions:** It is possible to design a simulator that is both more evidence-based and more locally valid than existing models. EBMI and its source code are now available to other researchers, clinicians and managers.

### Diabetes

### Factors Associated With Continued Inertia Among Patients With Diabetes

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**Objectives:** To estimate the prevalence of and factors associated with inertia among patients with diabetes. **Methods:** Using automated clinical and pharmacy data, we identified an insured cohort of patients with diabetes at the time they initiated oral monotherapy during the period, 2000-2005 (n=5082). Actuarial methods were used to estimate time to inertia (defined as 2 HbA1c values over 8% at least 90 days apart, not yet dispensed insulin with no medication change in the preceding 90 days). Among the subset facing inertia (n=1391), actuarial methods and Cox regression were used to estimate time to and factors associated with appropriate care defined as either a medication intensification (dose change, class change, or class addition) or an HbA1c  $\leq 7\%$ . **Results:** At inception, mean age of the cohort was 60.1 years, mean HbA1c was 8.6% and 97% were dispensed either Sulfonylurea or Metformin. Forty-eight percent were female and 37% African American. Eight percent of patients faced inertia within 1 year, 18% within 2 years, 26% within 3 years and 33% within 4 years. Before the time of inertia, 35% had been dispensed combination therapy. At the time of inertia, 20% had no medication on hand (i.e., were non-persistent in their medication use) and mean HbA1c was 9.7% (range 8.1%-18.9%). Mean time to appropriate care was 7.3 months, with 27% having neither an intensification nor HbA1c  $\leq 7\%$  within 1 year. Those with no medication on hand (hazard ratio (HR)=0.67; 95% CI, 0.56-0.82) and those who had progressed to combination therapy (HR=0.86; 95% CI, 0.76-0.98) faced longer delays. Increased delays were also associated with increasing drug co-payments (HR=0.95; 95% CI, 0.92-0.98). HbA1c levels greater than 11% (HR=1.48; 95% CI, 1.11-1.97) were associated with shorter dispensings, as were dispensings for an anti-hypertensive (HR=1.17; 95% CI, 1.01-1.37), lipid lowering (HR=1.19; 95% CI, 1.03-1.37), and anti-depressant (HR=1.46; 95% CI, 1.17-1.82)