CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
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Project Number
S0321

Project Title
Analysis of Unwarranted Variation in Healthcare Costs and Delivery

Abstract

Objectives/Goals

Unwarranted variation, a phenomenon in the healthcare sector, refers to wide ranges of discharge rates, Medicare payments, and, most crucially, care delivery. Unwarranted variation costs patients hundreds of days in hospitals and the US billions of dollars yearly. The research aims to establish causes of unwarranted variation within supply-sensitive (limited by facility) and effective (by-the-books) care, which account for 76% of all unwarranted variation.

Hypotheses: 1. A large number of providers increase the complexity of a system, compromising care.
2. A large number of resources increase the complexity of the system, compromising care.
3. The more "complex" (doctor numbers, beds, hospital size) a healthcare system gets, the less effective it gets at covering the basics (eg. Pneumonia or heart attack care)
4. Effective care is unrelated to socioeconomic factors.

Methods/Materials

Hypotheses were evaluated through statistical analysis of existing databases of rates of supply-sensitive and effective care on the HRR (Hospital Referral Region) level. Databases were obtained from the Dartmouth Atlas of Healthcare, the Census, and Medicare agencies. SQL macros written in Access allowed "joins" over multiple databases, and enabled running linear, multivariate, and logistic regressions on many data sets. The most difficult step of my procedure was quantifying the "complexity" I was trying to measure. Based on preexisting research, composite numbers to describe this concept were created.

Results

1. There was an R^2 of .636 between "resource inputs" (doctors, spending, etc.) and system complexity, demonstrating a strong correlation between the two.
2. Provider and hospital bed increases lead to higher per capita Medicare spending (R^2=.548).
3. This result was reinforced by a high Spearman#s rho of .438 between specialist providers and spending (p value < 0.001).
4. Low R^2 values on regressions indicated that the relationship between complexity factors (such as Medicare spending, etc.) & effectiveness of care delivery is not correlated.
5. Delivery of effective care is becoming more standardized compared to previous years.

Conclusions/Discussion

My hypothesis was not completely validated: while resource inputs are tied to complexity, system complexity has no conclusive impact on care. Socioeconomic factors were tied to education-based effective care, but not to procedure-based effective care.

Summary Statement

In healthcare systems, system complexity does not impact care quality, though increased resource inputs (like doctors, spending) are correlated with system complexity.

Help Received

Mother helped with presentation; Father helped with learning about SQL