An Analysis of Primary Care Providers in Arizona’s 126 Primary Care Areas (PCAs) and their Effect on Mortality and Morbidity

Michael Wassermann, MS4, Jonathan Cartsonis, MD, Mentor

Abstract

Research questions: Is there any association between the total number of primary care providers and mortality per 100,000 persons (all deaths, heart disease, all cancer, chronic lower respiratory disease, and all accidents), or morbidity per 100,000 persons (chronic diseases, congestive heart failure, hypertension, uncontrolled diabetes, and strokes)? Is there any difference in total number of primary care providers, mortality per 100,000 persons, or morbidity per 100,000 persons in rural vs urban primary care areas?

Background: The United States is currently facing a primary care provider shortage. Medical schools nationwide have increased enrollment in order offset the effects of the shortage. In order to judge the effects of increasing total quantity of future physicians, there should be a demonstrated relationship between total quantity of providers and a reduction in mortality / morbidity at a population level.

Methods: Data was gathered from the Arizona Department of Health Services community profiles dashboard. 2013 mortality / mortality data for all 126 of Arizona’s Primary Care Areas was analyzed utilizing linear regression and Wilcoxon rank sum.

Results: Linear regression demonstrated a statistically significant reduction in a number of mortality / morbidity categories as total number of primary care providers increased. Correlation data demonstrated a statistically significant relationship between number of primary care providers and increase in chronic lower respiratory diseases (p < 0.001). Additionally, rural primary care areas showed higher incidence of congestive heart failure (p < 0.001) and chronic diseases (p < 0.02) and lower total numbers of primary care providers (p < 0.001) compared with urban primary care areas.

Conclusions and Impact: Our findings demonstrate distinct differences between urban and rural primary care areas. There may be some association between total number of primary care providers and their potential effect on mortality/morbidity incidence. Further research needs to be completed in order to elucidate a greater understanding of these potential relationships.

Introduction

According to a report published in 2013 by the Association of American Medical Colleges (AAMC), Arizona ranked 43rd in the nation for its shortage of primary care physicians. In response to the perceived impending physician, medical schools nationwide have increased enrollment in an effort to offset the potential adverse effects of the shortage despite the fact that graduate medical education residency spots have remained relatively stagnant since the mid-1990s.

In order to judge the need to substantially increase the overall number of physicians, state officials should be able to clearly demonstrate that regional health areas with low primary care providers to patient ratios have a higher rate of all cause mortality and morbidity. Our research project aims to explore the relationship between all cause mortality / morbidity and primary care physician delineated by primary care areas as defined by the Arizona Department of Health Services utilizing data from 2013.

Methods

2013 public health data were made available from the Arizona Department of Health Services (AZDHS) community profiles dashboard. Individual community profile data for 126 of 126 of Arizona’s Primary Care Areas (PCAs) were then extracted and obtained for the following fields: total number of primary care providers, mortality per 100,000 (all deaths, heart disease, all cancer, chronic lower respiratory disease, all accidents), and morbidity per 100,000 (stroke, chronic diseases, congestive heart failure, hypertension, uncontrolled diabetes). Additionally, utilizing the AZDHS community profiles dashboard, we further compared the following variables for “rural” vs “urban” PCAs: total number of primary care providers, mortality per 100,000 (all deaths, heart disease, all cancer, chronic lower respiratory disease, all accidents), and morbidity per 100,000 (stroke, chronic diseases, congestive heart failure, hypertension, uncontrolled diabetes).

For the purpose of univariate linear regression analysis, the data was separated into quartiles. Wilcoxon rank sum was utilized to compare the total number of primary care providers, mortality, and morbidity in 41 rural vs 65 urban PCAs.

Table 1: Univariate linear regression comparing total number of primary care providers to mortality and morbidity per 100,000 persons.

Table 2: Wilcoxon rank sum analysis between rural and urban PCAs evaluating total number of primary care providers, mortality per 100,000 persons (all deaths, heart disease, all cancer, chronic lower respiratory disease, all accidents), and morbidity per 100,000 persons (stroke, chronic disease, congestive heart failure (CHF), hypertension, and uncontrolled diabetes).

Discussion and Conclusions

Research Question 1: Is there any association between the total number of primary care providers and mortality per 100,000 persons (all deaths, heart disease, all cancer, chronic lower respiratory disease, and all accidents), or morbidity per 100,000 persons (chronic diseases, congestive heart failure, hypertension, uncontrolled diabetes, and stroke)?

Discussion: Through univariate linear regression analysis comparing total number of primary care providers to mortality categories per 100,000 persons, our findings demonstrate statistical significance with a negative linear correlation in the following categories: all deaths, heart disease, and all accidents when quantified into four quadrants. As the number of primary care providers increased, there was a significant reduction in all deaths from cancer with total number of primary care providers in the 15 to 46 range, but no statistically significant reduction in mortality past this range. There was no statistically significant relationship between total number of primary care providers and deaths from chronic lower respiratory disease.

Additionally, through univariate linear regression analysis comparing total number of primary care providers to morbidity categories per 100,000 persons our findings demonstrate statistical significance with a negative linear correlation in the following categories: chronic diseases and uncontrolled diabetes. As the number of primary care providers increased, there was a total reduction across all provider quadrants. Morbidity per 100,000 persons approached statistical significance in the category of congestive heart failure.

Research Question 2: Is there any difference in total number of primary care providers, mortality per 100,000 persons, or morbidity per 100,000 persons in rural vs urban primary care areas?

Discussion: Wilcoxon rank sum demonstrated a statistically significant difference between total number of primary care providers, congestive heart failure, and chronic diseases in rural vs urban primary care areas. Urban primary care areas had a greater total number of primary care providers and rural areas showed higher rates of congestive heart failure and chronic diseases per 100,000 persons.

Limitations: First and foremost, correlation does not equal causation. While our analyses demonstrate statistical significance in a few categories, there are a number of confounding factors that would prove a relationship exists when in fact there may not be one. Additionally, data was only available from 2013 and future investigations will need a more robust, longitudinal data set to analyze.

Conclusions: There is a statistically significant relationship in the reduction of certain causes of mortality per 100,000 persons as the total number of primary care providers increases. Additionally, there are a greater number of primary care providers in urban primary care areas, and there is a higher incidence of congestive heart failure and chronic diseases per 100,000 persons in rural primary care areas.

Acknowledgements

I wish to thank my mentor Dr. Jonathan Cartsonis for his guidance and tireless commitment to furthering his students’ education. Additionally, this project would not be possible without Paul Kang’s statistical analyses, and Jonathan Lapenn’s creative genius.

References

Figure 1: Correlation matrix between number of primary care providers and incidence of mortality from all deaths, heart disease, all cancer, chronic lower respiratory disease, and all accidents per 100,000 individuals in Arizona in 2013. Correlation coefficients listed at the bottom of the figure.

Figure 2: Comparison of the incidence of chronic diseases per 100,000 persons in rural vs urban primary care areas.

Figure 3: Comparison of the incidence of congestive heart failure (CHF) cases per 100,000 individuals in rural vs urban primary care areas and the total number of primary care providers per 100,000 in rural vs urban primary care areas in Arizona in 2013.