INTRODUCTION

Nearly 1 billion people worldwide do not have access to health care workers.

Lack of access has become a health care crisis that impedes the Millennium Development Goals of achieving health for all by World Health Organization.¹ ²

There is an overall public health concern due to inadequate supply of the healthcare workforce.³ ⁴

This workforce supply issue is most pronounced in rural and remote areas, and results in maldistribution of the health care workforce.³ ⁴

As part of the healthcare workforce, pharmacists assume an increasing role in cost-effective health interventions such as preventive, public health services and the management of increasingly costly and complex pharmaceutical agents.

As part of the healthcare workforce, pharmacist maldistribution issues are also prevalent in all areas,³ ⁴ especially in rural and underserved communities compared with urban areas.

The maldistribution of pharmacist workforce may lead to suboptimal overall well-being of the population.⁵ ⁶

STUDY OBJECTIVE

To assess the impact of pharmacist maldistribution on self-reported health in rural and urban counties in the US.

METHODS

Data

Est 2010 Area Health Resource File (AHRF) was used to extract county-level data in each county in the US, including:

- County-level licensed pharmacist (census data from 2000 and 2009)
- County-level population (census data from 2000 and 2009)
- Urban and rural county indicators (most recent)
- 2009-12 Behavioral Risk Factor Surveillance System (BRFSS) data were merged and used to extract self-reported individual-level variables, including:
  - Impaired physical health ( overseen by last 30 days)
  - Impaired mental health days (within last 30 days)
  - General health status (1=excellent; 2=very good; 3=good; 4=fair; 5=poor)
  - Age
  - Gender
  - Ethnicity
  - Employment status
  - Education
  - Insurance status
  - Marital status

Analysis

- Multinomial logistic (MNL) model was used to estimate the relative risk of pharmacists per 10,000 population in either urban or rural counties on the general health status, controlling for individual-level predictors.

\[
 p_i = \frac{e^{\beta_i}}{1 + \sum_j e^{\beta_j}}, \quad j = 1, \ldots, m. \tag{1}
\]

- To estimate the distinctive impact of pharmacist supply on physical and mental health, a linear system of equations: seemingly unrelated regression (SUR) model was employed, controlling for the same set of individual-level predictors.

The SUR model simultaneously predicts the impact of pharmacist supply on physical health and mental health, which is specified as:

\[
 y_i = X_i\beta + u_i, \quad i = 1, \ldots, N \tag{2.1}
\]

- For the current analysis, the two dependent variables \( y \), which are impaired physical and mental health days in the past 30 days; the predictors \( X \) as specified above.

- Stacking over \( N \) individuals gives

\[
 \begin{bmatrix}
 y_1 \\
 y_2 \\
 \vdots \\
 y_N \\
 \end{bmatrix} = \begin{bmatrix}
 X_1 \\
 X_2 \\
 \vdots \\
 X_N \\
 \end{bmatrix} \begin{bmatrix}
 \beta_1 \\
 \beta_2 \\
 \vdots \\
 \beta_m \\
 \end{bmatrix} + \\
 \begin{bmatrix}
 u_1 \\
 u_2 \\
 \vdots \\
 u_N \\
 \end{bmatrix} \tag{2.2}
\]

- Where \( y \) and \( u \) are \( G \times 1 \) vectors, \( X \) is a \( G \times K \) matrix and \( \beta \) is a \( K \times 1 \) column vector

RESULTS

Table 1: Multinomial Logistic (MNL) Model Estimations

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<th>Predictor</th>
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Table 2: Seemingly Unrelated (SUR) Model Estimations

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DISCUSSION

There was a substantial increase of pharmacist supply since 2000.

For US counties that were defined to be completely rural, the average registered pharmacists increased by 6.284 per 10K population in 2009, compared with 2000.

Despite the increase in overall registered pharmacists in the US, the average pharmacist supply in rural counties was still 35% less than in non-rural counties in 2009.

Table 1:

- Residing in a rural county, compared with residing in an urban county, had greater the risk to report poor health: 35.2% more likely in 2000 and 44.4% more likely in 2009 (p<0.01).
- Increasing one pharmacist per 10K population reduced the risk of reporting poor physical health by about 0.386, relative to residents with 0.001.
- Males and Hispanics were more likely to report poor health compared with females and non-Hispanics for both 2000 and 2009 (p<0.01).
- Those who were employed, had health insurance, married, had college degree were less likely to report poor health, compared with otherwise, for both 2000 and 2009 (p<0.01).

Table 2:

- Residing in rural county, relative to urban: increased impaired physical healthy days by 0.386 in 2000 and 0.398 in 2009 (p<0.01).
- Residing in rural county, relative to urban: increased impaired mental healthy days by 0.204 in 2000 and 0.177 in 2009 (p<0.01).
- Increasing one pharmacist per 10K population reduced the impaired physical healthy days by 0.026 in 2000 and 0.037 in 2009 (p<0.01).
- Increasing one pharmacist per 10K population reduced the impaired mental healthy days by 0.006 in 2000 and 0.018 in 2009.
- Hispanics were more likely to incur physical health impairment, rather than mental health impairment (p<0.01).
- Being employed had the least impact on both physical and mental health impairments, followed by having a college degree (p<0.01).

CONCLUSIONS

Based on the findings:

- The pharmacist maldistribution may have contributed the intra-country health disparities between urban and rural counties in the US
- The impact of inadequate pharmacist supply was greater on physical health compared with mental health, and consistent over time.
- The potential substitution effects between different health care providers are warranted when estimating the impact of a specific health care provider on people’s well-being.

REFERENCES

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