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Abstract

Insufficient healthcare access has been a principal concern for policymakers and health care providers. And yet, fewer Americans in 2015 had a primary care provider than in 2002. Worsening healthcare access presents an immediate problem and warrants a prompt solution. One potential solution to this problem involves integrating more International Medical Graduates (IMGs) into the medical workforce. In this investigation, we evaluated the effect of (1) IMG trainees (residents and fellows) and (2) all IMGs (including trainees) on mortality rates. We found no evidence that the addition of IMG trainees affects mortality rates, both in the aggregate and across different genders and most of the races of patients. Our study did show an increased mortality rate for Black patients. In contrast to the effect with only IMG trainees, we found strong evidence that the addition of IMGs is associated with a decrease in the mortality rate. Ultimately, these findings suggest that post-residency and fellowship IMGs could solve the American healthcare crisis, but more research is needed on the effect of IMGs on patient outcomes during their residency and fellowship period.

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Introduction

Despite the landmark legislation that was the Affordable Care Act, Levine *et al*. (2020) found that only 75 percent of Americans had access to a primary care provider in 2015, down from the 77 percent of Americans in 2002. And by 2033, the American Association of Medical Colleges projects that the healthcare shortages will grow to between 54,100 and 139,000 physicians (Dall *et al.*, 2019). The decrease in healthcare access highlights the intractable nature of the American healthcare shortages.

In response to the healthcare shortages, policymakers could (1) promote telehealth technologies, (2) train more domestic medical graduates (USMGs), or (3) accept more international medical graduates (IMGs) (i.e., physicians who have completed medical school outside the United States). Considering the immediate threat of healthcare shortages, however, the first two solutions are impractical given their lengthy timeframes. Thus, the third option—integrating more IMG into the healthcare workforce—is the only viable solution.

Although accepting more IMGs may seem like a simple solution, many healthcare professionals harbor concerns about the quality of education of IMGs especially compared to USMG. Kinchen *et al.* (2004) surveyed US-born primary care physicians and found that they refer patients to IMG specialists at lower rates. These physicians' concern is not totally without support, particularly for Black elders who, according to Howard *et al*. (2006), reported feelings of receiving inadequate amounts of healthcare. White elders were similarly dissatisfied with IMG-based care, which stemmed from the perception of receiving unnecessarily expensive care. And yet, Rhee *et al.* (1986) evaluated physician quality in ambulatory care settings and found no difference in the quality of care provided by IMGs and USMGs. Notably, Black patients received better care from young USMGs and older IMGs.

In stark contrast to Rhee *et al.* (1986) and Howard *et al.* (2006), Norcini *et al.* (2010) found that patients with congestive heart failure or with myocardial infarction had a lower mortality rate with foreign IMGs compared with patients with their US-trained counterparts. Upon examining health outcomes for Medicare patients, Tsugawa *et al.* (2017) similarly found that patients of IMGs had lower mortality rates than patients of USMGs. Together, these findings suggest that IMGs provide superior care healthcare. However, both authors found that patients of IMGs used more healthcare compared to patients of USMGs: Norcini *et al.* (2010) found that patients of IMGs had longer hospital stays and Tsugawa *et al.* (2017) found that patients of IMGs had higher healthcare costs.

However, neither Norcini *et al.* (2010) nor Tsugawa *et al.* (2017) directly investigated the quality of care provided by IMGs during their residency and fellowship period. If IMGs needed time to adapt to the American healthcare system, which would manifest in increased mortality during residency and fellowship and decreased mortality rates thereafter, the total effect of IMGs would be positive. After all, residency and fellowship (3-7 years) are a small proportion of the practice period for physicians.

Both studies also compared mortality rates between USMGs and IMGs. This approach may misestimate the effect of IMGs if IMGs affected the quality of care provided by their domestically trained colleagues. For instance, if IMGs provided high-quality care and improved the care of their USMG peers by association, then one may find that IMGs provide similar levels of care as USMGs, although the addition of the IMG substantially improved healthcare quality. Therefore, researchers should supplement their studies with investigations into the total effect of IMGs rather than merely the effect of IMGs compared to USMG.

Thus, we studied the effect of IMG trainees (residents and fellows) and the effect of all IMGs (including IMG trainees) on mortality rates. We separately investigated the effect of IMG trainees to account for possible aggregation bias. Additionally, we evaluated the community effect of IMGs (as opposed to their comparative effect) to limit the weight that IMG's effect on USMG quality of care would have in our investigation.

Methodology

Effect of IMG trainees

We combined IMG trainee (resident and fellow) data from the AAMC State Physician Workforce Databook in 2007, 2009, 2011, 2013, and 2015 with race and sex segmented mortality data from the CDC Wonder mortality database as the basis of our investigation (AAMC, 2007; AAMC, 2009; AAMC, 2011; AAMC, 2013; AAMC 2015; CDC, 2017). In addition, we added two control variables: percent internet access from the American Community Survey and the Current Population Survey (Tolbert & Mossberger, 2015) and the unemployment rate (Kassel, n.d.)

By incorporating internet access and unemployment rate into, we accounted for factors other than physician supply that could affect mortality rates. For instance, a household without internet access will not be able to access telehealth services. Similarly, unemployed patients may have greater exposure to environmental stressors and other sociocultural factors that are associated with worse health outcomes.

Using such data sources, we constructed a state and year fixed effects model that measured the effect of IMG trainees on both aggregate mortality rates and mortality rates[1] for men, women, Black, White, and Asian American and Pacific Islander (AAPI) patients. Thus, each observation

[1] We calculated the mortality rates by dividing the population's total deaths by the population's size

represents a state in a year, so with 50 states and 5 years and one missing observation, we had 249 observations. Because certain states had 0 deaths for a given race and gender, we were unable to compute mortality rates for those states in that year. Thus, we had 233 observations that represented AAPI mortality rates and 246 observations that represented Black mortality rates.

We were initially concerned about collinear variables in our model, but, as table 1 demonstrates, the population of IMG residents and fellows appears to be uncorrelated with internet access and the unemployment rate. Therefore, it seems unlikely that the estimated standard errors are inflated (Table 1). Table 1 also suggests that IMG residents and fellows tend to practice in states with a higher proportion of Black populations and a lower proportion of AAPI populations.

Table 1: Shows a correlation table between both control variables and populations included in the study.

	IMG residents and fellows	Internet Access	Unemployment Rate	Female Population	Male Population	White Population	AAPI Population	Black Population
IMG residents and fellows	1.00							
Internet Access	0.07	1.00						
Unemployment Rate	0.15	0.26	1.00					
Female Population	0.58	0.00	0.25	1.00				
Male Population	0.56	-0.00	0.25	1.00	1.00			
White Population	0.56	0.00	0.24	0.99	1.00	1.00		
AAPI Population	0.35	0.10	0.18	0.82	0.83	0.80	1.00	
Black Population	0.64	-0.10	0.27	0.82	0.81	0.79	0.50	1.00

Effect of IMGs (including trainees)

To determine the effect of all IMGs including trainees, we used data that was compiled from the Area Health Resource File. (Department of Health & Human Services, 2021). Using that data, we compared county mortality rate from the Census Bureau's Annual Resident Population Estimates with the county population of IMGs (including trainees) described in the American Medical Association's (AMA) Physician Masterfile (Bureau's Annual Resident Population Estimates, n.d.; AMA, n.d.). Because we used county year-level data instead of state year-level, we could not disaggregate the mortality rates by race and sex, but we could test the effect of IMGs on mortality rates in primary care shortage, partially primary care shortage, and non-primary care shortage areas as defined by the Health Resources and Services Administration (Health Resources and Services Administration, n.d.). We also studied the effect of IMGs on inpatient days and outpatient visits as reported by the American Hospital Association's (AHA) Annual Survey (AHA, n.d.).

We hoped that studying the relationship between IMGs on county utilization would reveal the mechanism by which IMGs affect mortality rates.

Because of similar data issues, we could not include an internet access control variable. We replaced internet access with the percentage of Americans under 65 with insurance (Census Bureau's Small Area Health Insurance Estimates, n.d.). In addition, we included a percent unemployed variable because adverse environmental conditions and other sociocultural factors could culminate in higher baseline mortality rates for the unemployed.

Ultimately, we tested the effect of IMGs on county-level mortality, inpatient days, and outpatient visits using county and year fixed effects. The sample size for our investigation was roughly 18,840 observations, with any variation due to lack of data availability. We were less concerned about any multicollinearity between IMG residence and our control variables because of the significant effect observed.

Results

Effect of IMG trainees

We found no evidence that the addition of an IMG trainee affected the aggregate mortality rate, the mortality rate for AAPI and White patients, or the mortality rates for men and women (table 2 & table 3). However, as shown by table 2, the addition of an IMG trainee increased the mortality rate for Black patients. An additional IMG trainee is associated with a $5.34 * 10^{-7}$ percent increase in the statewide Black mortality rate.

Table 2: The effect of IMG resident and fellows on the mortality rate across races

	(1) Total	(2) Black	(3) AAPI	(4) White
IMG Residents and Fellows	-2.67e-09 [-0.000000141,0.000000135]	0.000000534*** [0.000000342,0.000000726]	-6.54e-08 [-0.000000192,6.14e-08]	9.14e-08 [-5.72e-08,0.000000240]
Unemployment Rate	-0.0000573 [-0.000147,0.0000319]	0.000415*** [0.000289,0.000540]	-0.0000158 [-0.000104,0.0000725]	0.00000133 [-0.0000947,0.0000973]
Internet Access	-0.0120*** [-0.0144,-0.00969]	-0.0202*** [-0.0235,-0.0170]	0.00124 [-0.000928,0.00341]	-0.0127*** [-0.0152,-0.0102]
N	249	246	233	249

95% confidence intervals in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Table 3: The effect of IMG residents and fellows on the mortality rate across sexes.

	(1) Total	(2) Male	(3) Female
IMG Residents and Fellows	-2.67e-09 [-0.000000141,0.000000135]	-5.85e-08 [-0.000000190,7.32e-08]	5.28e-08 [-9.60e-08,0.000000202]
Unemployment Rate	-0.0000573 [-0.000147,0.0000319]	-0.0000241 [-0.000109,0.0000610]	-0.0000904* [-0.000187,0.00000577]
Internet Access	-0.0120*** [-0.0144,-0.00969]	-0.0136*** [-0.0158,-0.0113]	-0.0106*** [-0.0131,-0.00808]
N	249	249	249

95% confidence intervals in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Effect of IMGs (including trainees)

We found that the addition of an IMG was associated with decreased county mortality rates (by roughly 1.38 * 10^{-6} percent) and increased healthcare utilization (approximately 752 more inpatient days and 2355 more outpatient visits) (table 3). Upon disaggregating the data by primary care need, we found that the addition of an IMG in non-shortage areas decreased the mortality rate by 2.81* 10^{-6} percent, and increased days hospitalized by 494 days and outpatient visits by 1826 outpatients' visits (table 4).

Table 4: The effect of IMGs (including IMG trainees) on the mortality rate, inpatient days and outpatient visits across all observed counties.

	(1) Mortality Rate	(2) Inpatient Days	(3) Outpatient Visits
IMG	-0.00000138*** [-0.00000150,-0.00000126]	751.7*** [747.1,756.4]	2355.8*** [2335.2,2376.3]
Unemployment Rate	0.000360*** [0.000342,0.000378]	-1102.6*** [-1794.7,-410.5]	-3537.4** [-6580.3,-494.6]
Percent without insurance	-0.0000307*** [-0.0000378,-0.0000237]	-62.04 [-336.9,212.8]	-8771.8*** [-9981.0,-7562.6]
N	18846	18837	18847

95% confidence intervals in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Table 5: The effect of IMGs (including IMG trainees) on the mortality rate, inpatient days and outpatient visits across observed non-shortage counties.

	(1) Mortality Rate	(2) Inpatient Day	(3) Outpatient Visits
IMG	-0.00000281***	494.2***	1825.7***
	[-0.00000353,-0.00000208]	[477.3,511.1]	[1723.0,1928.4]
Unemployment Rate	0.000496***	1294.4*	6886.3
	[0.000432,0.000559]	[-192.9,2781.6]	[-2143.1,15915.7]
Percent without Insurance	-0.0000250**	653.4**	-1601.7
	[-0.0000464,-0.00000354]	[154.2,1152.7]	[-4631.2,1427.8]
N	2051	2049	2051

95% confidence intervals in brackets
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < .01$

Conversely, in counties that are entirely shortage areas or partially shortage areas, the addition of an IMG is associated with, respectively, a 9.66* 10^{-7} and 1.41* 10^{-6} percent decrease in the mortality rate, an increase of 843 and 746.5 days hospitalized, and nearly 2565 and 2338 more outpatient visits (table 5 & table 6).

Table 6: The effect of IMGs (including IMG trainees) on the mortality rate, inpatient days and outpatient visits across observed partly shortage counties.

	(1) Mortality Rate	(2) Inpatient Days	(3) Outpatient visits
IMG	-0.00000141***	746.5***	2338.4***
	[-0.00000155,-0.00000128]	[739.7,753.2]	[2308.4,2368.4]
Unemployment Rate	0.000384***	-2518.4***	-10904.1***
	[0.000356,0.000411]	[-3898.0,-1138.7]	[-17064.9,-4743.4]
Percent without Insurance	0.00000836	30.90	-13355.5***
	[-0.00000203,0.0000188]	[-486.6,548.4]	[-15666.5,-11044.6]
N	9208	9208	9208

95% confidence intervals in brackets
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < .01$

Table 7: The effect of IMGs (including IMG trainees) on the mortality rate, inpatient days and outpatient visits across observed shortage counties.

	(1) Mortality Rate	(2) Inpatient Day	(3) Outpatient Visits
IMG	-0.000000966***	843.0***	2564.6***
	[-0.00000141,-0.000000520]	[834.9,851.1]	[2535.9,2593.2]
Unemployment Rate	0.000307***	-461.9	1086.5
	[0.000274,0.000341]	[-1071.7,147.9]	[-1065.9,3238.9]
Percent without Insurance	-0.0000960***	-166.2	-2315.7***
	[-0.000110,-0.0000814]	[-430.7,98.26]	[-3249.2,-1382.3]
N	4446	4444	4447

95% confidence intervals in brackets
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < .01$

Discussion

First, we studied the effect of International Medical Graduate trainees on mortality rates using state and year fixed effects and internet access and unemployment rate control variables. Our use of fixed-effects should account for the unobserved heterogeneity across states and years. In our investigation, we found no evidence that IMGs affect the aggregate mortality rate or the mortality rates for White, AAPI, male and female patients. However, we found evidence that IMG residents and fellows increased Black mortality rates. This finding supports Rhee et al. (1986)'s finding that younger IMGs provide worse healthcare to Black patients than their younger USMG counterparts. Overrepresentation of young IMGs in Howard *et al*.'s (2006) study could also explain the feelings of receiving insufficient healthcare by Black elders.

However, these findings need appropriate context. The magnitude of the increase in mortality was not large enough to dominate the overall effect of IMG residents and fellows on mortality (which still had a negative coefficient). In addition, if there are a fixed number of residency spots, the addition of an IMG trainee must entail the loss of a USMG trainee. Therefore, researchers should interpret these results as a comparative analysis of the quality of care of USMG trainees versus IMG trainees. With that understanding, these findings suggest that the quality of care from USMG trainees and IMG trainees is not significantly different in the aggregate, but that USMG trainees provided significantly better care for Black patients than IMG trainees. In addition, the IMG trainee category included domestic IMG trainees (US citizens who attended medical school in the Caribbean) and foreign IMG trainees. Given Norcini *et al.*'s (2010) finding that patients of domestic IMGs had a higher mortality rate than foreign IMGs and USMGs, it is possible that care from domestic IMG trainees resulted in the observed higher mortality rates for Black patients. Ultimately, policymakers should be cautious in adjusting immigration policy based on these findings, but should investigate any cultural barriers that might exist between Black patients and IMG trainees. Researchers should also retest this study's findings after separating foreign and domestic IMG trainees.

Next, we studied the effect of IMGs (including IMG trainees) on mortality rates and healthcare utilization. Overall, we found that the addition of an IMG significantly increased inpatient days and outpatient visits and decreased the mortality rates. The increase in healthcare utilization adds credence to the theory that the increased integration of IMGs into the healthcare workforce increases healthcare access. However, the addition of an IMG in non-shortage areas was associated with the largest decrease in mortality, but the smallest increase in healthcare utilization.

This finding indicates that some healthcare provided by IMGs in partly and fully shortage areas may be unnecessary, insofar as it does not reduce mortality rates. This finding supports the testimony of White elders surveyed in Howard et al. (2006), Norcini *et al.*'s (2010) finding that patients of IMGs were hospitalized for greater periods of time, and Tsugawa *et al.*'s (2017) finding that the healthcare provided by IMGs tended to be more expensive. However, more research is needed before concluding that some IMG care in partly and fully shortage areas is unnecessary. Another byproduct of our finding that IMGs in non-shortage areas decreased mortality rates by the largest magnitude is that either (1) that UMGs and IMGs are compliments or (2) that IMGs are heterogenous and that non-shortage areas select for the best IMGs. Future researchers should also investigate both explanations to motivate future healthcare policy as the reservation of the best IMGs in non-shortage areas, if that is the true reason, is likely nonoptimal.

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