INFLUENCE OF PATIENT IMMIGRANT STATUS ON PROVIDER DIABETES TREATMENT DECISIONS: A VIRTUAL PATIENT EXPERIMENTAL STUDY

by

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For my family and everyone I have ever considered family.

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ABSTRACT

Immigrants are at elevated risk for not having their diabetes treatment appropriately intensified, likely resulting in poorly-controlled diabetes and increased morbidity and mortality. Immigrant status is a powerful sociodemographic cue, yet its influence on providers' diabetes treatment decisions is unknown. The study objective was to determine the effect of patient immigrant status on providers' decisions to (1) take no action, (2) add an oral hypoglycemic agent (OHA), (3) add/switch to insulin, or (4) refer the patient to an endocrinologist. Participants were 140 medical students/professionals ('providers'). Providers viewed profiles (videos + vignettes) for virtual patients differing in immigrant status (born in Mexico or U.S.; other characteristics held constant). Analyses were completed at the group ('nomothetic') and individual ('idiographic') levels. Nomothetic results indicated providers were less likely to refer foreign-born patients to endocrinology than U.S.-born patients (p=0.03). No differences were detected for the other three treatment likelihood ratings. Idiographic results indicated that about half of provider decisions were influenced by patient immigrant status (i.e., Cohen's $d \geq 0.50$) across all four treatment decisions. Effect size data show an almost even split between higher treatment ratings for foreign-born vs. U.S.-born patients for three decisions (take no action, add an OHA, add/switch to insulin), explaining why group-level differences for these ratings did not emerge (i.e., they were cancelled out). This study found that providers are less likely to refer foreign-born patients to endocrinology, potentially leading to therapeutic inertia. In addition, half of individual-level provider decisions were meaningfully influenced by patient immigrant status. However, traditional group-level analyses mask these important individual-level differences. These systematic differences in treatment based on non-relevant factors could lead to unintended adverse outcomes for the foreign-born population.

INTRODUCTION

Mexican Americans, versus non-Hispanic Whites, are less likely to have well-controlled diabetes (Selvin, Parrinello, Sacks, & Coresh, 2014) and their diabetes treatment intensified when clinically indicated (Rodondi et al., 2006). Evidence suggests that immigrant status is an important factor in this context. Foreign-born Mexican Americans (i.e., immigrants) have a two-fold greater risk of developing type 2 diabetes compared to U.S.-born Mexican Americans (Oza-Frank, Chan, Liu, Burke, & Kanaya, 2013). Unfortunately, immigrants in the U.S. report receiving lower-quality healthcare than their U.S.-born peers, including lower satisfaction with healthcare and higher reports of discrimination by providers (Derose, Bahney, Lurie, & Escarce, 2009; Derose, Escarce, & Lurie, 2007). Further, our previous epidemiologic study utilizing a sample representative of the U.S. population showed that immigrants with diabetes are about half as likely as their U.S.-born peers to be treated with insulin, even after adjustment for demographic factors, diabetes severity, diabetes duration, cardiovascular disease (CVD), and CVD risk factors (Hsueh et al., 2018). This difference is potentially problematic, as the American Diabetes Association (ADA) recognizes insulin as the most efficacious treatment for achieving glycemic control and states: "For patients with type 2 diabetes who are not achieving glycemic goals, providers should promptly initiate insulin therapy" (p. 557; ADA, 2017). Thus, the full range of therapies, from oral hypoglycemic agents (OHAs) to insulin, should be considered in treatment intensification decisions. Collectively, the available evidence raises the possibility that Mexican American immigrants with diabetes are a subgroup at particularly elevated risk of experiencing therapeutic inertia – i.e., not having their diabetes treatment appropriately intensified. As a result, this subgroup may be disproportionately contributing to the higher rates of diabetes-related hospitalizations (Hayes, 2012) and deaths (Hunt et al., 2011; McBean, Li, Gilbertson, & Collins, 2004) detected among Mexican Americans in general.

Although the causes of therapeutic inertia are multifactorial, evidence suggests that providers are more vulnerable to therapeutic inertia when treating certain health disparity groups (Rodondi et al., 2006). Further, populations in the U.S. that face greater health disparities are often the same that endure negative stereotypes (Balsa & McGuire, 2003). Providers, like all humans, are vulnerable to using stereotypes, and these negative stereotypes may interfere in the decision-making process and lead to unequal outcomes. Indeed, research shows that considerable

variability in provider treatment decisions can be attributed to factors that have no evidence base to support them. The literature documenting the impact of racial stereotypes on providers' medical decisions is particularly robust, and a growing number of investigations are examining stereotypes based on other patient characteristics, such as socioeconomic status and weight (FitzGerald & Hurst, 2017). These systematic differences in treatment based on non-relevant, non-clinical factors could lead to unintended adverse outcomes for certain groups. Thus, it is important to identify these non-relevant, non-clinical factors, quantify the magnitude of their influence, and ultimately intervene to reduce the likelihood that providers use such factors in medical decision-making.

While observational studies lack the experimental control to disentangle the unique effects of non-clinical factors from other meaningful factors, experimental methods, such as virtual patient (VP) technology and lens model methodology, can definitively identify factors that affect medical decision-making and quantify the magnitude of their influence. Studies employing experimental designs consistently find that healthcare providers knowingly and unknowingly use cues based on patient race/ethnicity (A. T. Hirsh, Hollingshead, Ashburn-Nardo, & Kroenke, 2015; Hollingshead, Matthias, Bair, & Hirsh, 2015; Stutts, Hirsh, George, & Robinson, 2010; Wandner et al., 2014) and gender (A. T. Hirsh, Alqudah, Stutts, & Robinson, 2008; A. T. Hirsh, Hollingshead, Matthias, Bair, & Kroenke, 2014; Hollingshead et al., 2015; Stutts et al., 2010; Wandner et al., 2014) in medical decisions. That these effects occur across disciplines (physicians, nurses, and dentists) and levels of experience (trainees to established clinicians) is a testament to the salient, potent, and pervasive influence of sociodemographic cues in medical decision-making.

Immigrant status is a powerful sociodemographic cue, and the degree to which providers' treatment decisions are based on immigrant status remains unknown. Evidence suggests that being foreign-born is associated with several negative stereotypes. For example, listeners rate speakers with Spanish accents (an indicator of being foreign-born [Cargile, Maeda, Rodriguez, & Rich, 2010]) to be low in competence (Hosoda, Nguyen, & Stone-Romero, 2012), and providers are less satisfied with their encounters with ethnic minority immigrant patients, citing frustrations over perceived lack of effort, difficult cultural differences, and poor rapport (Kamath, O'Fallon, Offord, Yawn, & Bowen, 2003). These beliefs about immigrant patients could lead to poor patient care and outcomes via therapeutic inertia (Grabovschi, Loignon, &

Fortin, 2013). These provider-held beliefs about immigrant patients may also influence patient attitudes and behaviors (Nam, Chesla, Stotts, Kroon, & Janson, 2011), as patients who perceive their interactions with providers as less positive are less likely to engage in health-promoting behaviors, including medication adherence (Blanchard & Lurie, 2004; Casagrande, Gary, LaVeist, Gaskin, & Cooper, 2007). Given the multitude of ways provider-held beliefs are thought to exert influence on patient health outcomes, it is necessary to identify the extent to which patient immigrant status influences providers' diabetes care for immigrant patients (Schmittdiel et al., 2008).

The overall purpose of this experimental study is to estimate the effect of patient immigrant status on providers' diabetes treatment decisions. This study examines four treatment decisions in order of therapeutic intensity: (1) to take no action at this time, (2) to add an OHA, (3) to add/switch to insulin, and (4) to refer to an endocrinologist. Consistent with our prior epidemiological work examining differences in pharmacological treatments for diabetes across immigrant status, the two primary decisions of interest are providers' decisions to add an OHA and decisions to add/switch to insulin. The two secondary decisions of interest (decision to take no action and decision to refer an endocrinologist) are exploratory.

This study utilized a virtual patient (VP) design and lens model methodology. VP designs capitalize on experimental control by eliminating the potential confounders that are inherent in designs that use human actors as patients (e.g., attractiveness). The lens model is a framework for understanding how individuals use information to make clinical decisions (Hammond, 1955). There are five components to the lens model framework: the judge, the criterion, the cues, the environment, and the judgments. As applied to the present study, the judge refers to the provider, who is tasked with making clinical decisions (judgments) about an outcome of interest (criterion). To inform these decisions, the judge relies on cues in the environment. In this study, the environment refers to the patient's entire clinical profile, and the cues refer to individual components of that patient's clinical profile (e.g., HbA1c and immigrant status). Lens model studies recommend a 5:1 profile-to-cue ratio (Cooksey, 1996) to ensure adequately powered analyses. After arriving at a judgment, the judgment is statistically modeled as a linear function of the cues. Because a linear regression coefficient is calculated for each cue, lens model studies are able to: (1) identify which cues are used to arrive to a judgment, (2) determine the relative

importance of those cues (as indicated by the size of the coefficient), and (3) describe the nature of the cue's influence (as indicated by the direction of the coefficient).

The lens model is advantageous for examining medical decision-making for two key reasons. First, this model assumes that providers differ in the degree to which they are influenced by a cue. For instance, some providers' decisions might be heavily influenced by an immigrant status cue, while others' decisions might be minimally influenced or not at all. Second, this model assumes that the direction of this influence differs among providers (e.g., an immigrant status cue might influence two different providers to make decisions in opposing directions). While these differences in individual providers' decision-making behavior are oftentimes averaged out in traditional group-level analyses, the lens model design instead treats these differences as meaningful. Clinically, these individual differences in provider decision-making behavior based on an immigrant status cue could manifest as differences in patient outcomes. Analytically, understanding the pattern of decision-making behavior across individual providers yields a richer context for interpreting the pattern of decision-making behavior across the group. For example, at the traditional group-level of analysis, finding a nonsignificant effect of an immigrant status cue on decision-making could indicate that most or all providers within the group were not influenced by the cue. However, it could also indicate that some providers within the group were indeed influenced by the cue but the cue led to decisions in opposing directions, thus cancelling out effects at the group level. Each interpretation leads to a different understanding of how patient immigrant status influences provider decision-making. For these reasons, in lens model studies like the present one, differences are statistically modeled at both the traditional group (nomothetic) and individual (idiographic) level.

METHODS

Overview

The institutional review board at Indiana University-Purdue University Indianapolis (IUPUI) approved this online VP experimental study. Participants (providers) received a $30 e-gift card for their participation, which they were told would take approximately 30 minutes. Data was collected from October 10th to November 14th of 2018.

Sample

A total of 140 providers were recruited from medical schools in the U.S. Midwest region. The lead investigator (L.H.) contacted medical school administrators to request distribution to the student body of the recruitment flyer. The recruitment flyer stated: "We are interested in understanding how primary care providers make diabetes treatment decisions for their patients, and how these treatment decisions are related to provider characteristics." Factors of interest were not specified in recruitment materials. Interested individuals were asked to contact the lead investigator to complete an eligibility screener. Eligibility criteria were designed to ensure a sample of medical students or professionals currently engaged in formal training, defined as clerkship through fellowship. Therefore, to be eligible for the study, providers had report all of the following during screening: (1) being 18 years or older, (2) having a medical degree or being currently enrolled in medical school, and (3) having completed at least one training experience in primary care.

This study specifically enrolled only medical trainees for three reasons. First, medical trainees are currently delivering patient care and will be the future healthcare providers of immigrant patients. Second, medical training represents a critical period in which trainees develop heuristics that will guide their decision-making process throughout their medical careers. Understanding these processes is an important aspect of developing future interventions designed to address the unintended differences in care. Third, because experts in academic medicine advocate for intervening on health disparities during medical training (Betancourt, 2006), this group is the likely target population of future intervention efforts designed to reduce health disparities. In sum, the selection criteria were designed to capture a sample representative of the

next generation of primary care providers to increase the relevancy of study findings to future intervention efforts. Moreover, this study required at least one training experience in a primary care context, as type 2 diabetes is typically treated in primary care (Davidson, 2010), and primary care physicians are more likely to experience therapeutic inertia than endocrinologists (Shah, Hux, Laupacis, Zinman, & van Walraven, 2005).

Procedure

Eligible providers accessed the online study using a unique link sent by the lead investigator. The informed consent statement included information on the study purpose and procedures, estimated time commitment, potential risks and benefits, voluntary and confidential nature of the study, compensation, investigator contact information, and withdrawal procedures. Providers were informed that the survey was anonymous and that emails collected for e-gift card distribution would be unlinked from survey responses. After providing informed consent, providers were directed to an instructions page that read: "You will now be asked to make a number of medical decisions for a total of eight patients presenting to your clinic for a diabetes-related follow-up." Providers were then presented one of eight VP profiles (two female Mexico-born, two male Mexico-born, two female U.S.-born, two male U.S.-born), which were presented in a random order generated by Qualtrics survey software for each provider (see *Patient Profiles*). Four diabetes treatment actions were presented directly underneath the patient profile, along with four accompanying visual analog scales and four Yes/No radio buttons (see *Providers' Diabetes Treatment Decisions*). After providers made their treatment decisions for the first VP, they were asked to click through to the next page to the second VP. Providers repeated this procedure until decisions were completed for all eight VPs. Next, providers were asked to complete questions regarding their demographics, training status, and training experiences, as well as to guess the study purpose. At the end of the survey, providers were directed to a separate survey to collect contact emails to receive the $30 e-gift card.

Materials

Patient Profiles

The eight VP profiles were designed to be similar (i.e., not differ meaningfully) on all aspects, except for the immigrant status cue (the experimental manipulation), so that the profiles would elicit similar provider treatment decisions if providers did not use the immigrant status cue. Patient profiles consisted of three parts: a video, a diabetes history paragraph, and a face sheet (see Figure 1 for an example).

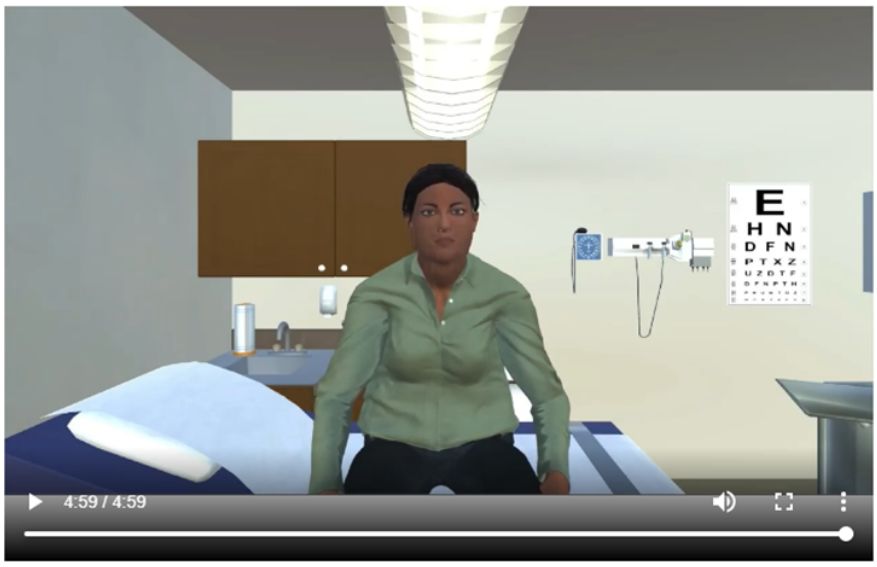
The five-minute video is shown on a continuous loop from the first-person perspective so that the VP is looking directly at the provider. The VP is shown seated on an exam table in a typical primary care patient room and behaving naturally (e.g., blinking, breathing, and slightly changing posture). VPs are dressed in casual clothing (jeans, blouses, button-down shirts). A professional animator created VPs from Adobe Fuse CC software. Adobe Fuse CC software allows users to customize from more than 20 base characters by manipulating over 280 attributes including hair, weight, and skin tones and texture. Adobe Fuse CC characters have a bone driven rig and a blendshape-based facial rig for facial movements.

The diabetes history paragraph presented underneath the video provides the VP's honorific (Mr./Ms.) and last name. Specific last names were selected according to the top eight most common Hispanic last names based on the 2010 U.S. Census: Garcia, Rodriguez, Martinez, Hernandez, Lopez, Gonzalez, Perez, and Sanchez. Information (possible values in this study) was provided for age (56-65 years), gender (male/female), years since diabetes diagnosis (4-6 years ago), and HbA1c at diagnosis (7.1%-7.8%). Values for age, years since diabetes diagnosis, and HbA1c at diagnosis were assigned to profiles using a random number generator. To address potential provider concerns regarding receipt of lifestyle counseling, contraindications, and patient preference, all face sheets stated the following: "[Mr. Garcia] has received counseling on lifestyle changes. [He] has no contraindications for common treatment options for diabetes, and [he] is open to all treatment options. Please see additional information below."

The face sheet was presented below the diabetes history paragraph. The face sheet contained the immigrant status cue (the experimental manipulation) embedded in the demographic information. Specifically, country of origin was listed as "Mexico" for the four Mexico-born VPs or "United States" for the four U.S.-born VPs. Name, sex, and age were

restated along with ethnicity (Hispanic for all) and race (White for all). All face sheets also indicate insurance coverage (yes for all). Problems listed were type 2 diabetes, hypertension, hyperlipidemia, overweight/obesity, and one of the following: gout, low back pain, upper respiratory infection, or osteoarthritis (assigned using a random number generator). All VPs were prescribed 2000mg of metformin and a second OHA – half were prescribed 100mg sitagliptin, and half were prescribed 4mg glimepiride (balanced across immigrant status and gender). Half of the VPs prescribed sitagliptin and half of the VPs prescribed glimepiride were prescribed 10mg amlodipine (i.e., four total VPs were prescribed amlodipine). Additional medications with dosages were ACE inhibitor (10mg for all), and atorvastatin (20mg, 40mg, or 80mg; assigned using a random number generator). Other information included current values for blood pressure, heart rate, respiratory rate, temperature, body mass index (BMI), low-density lipoprotein (LDL) cholesterol, and estimated glomerular filtration rate (eGFR). Values for these results varied slightly, but not meaningfully, across VPs to increase study realism and were typical of a person with diabetes.

Face sheets also included current HbA1c (8.3%-8.6%), which were calculated by raising HbA1c at diagnosis values by 0.6%-1.2% (assigned using a random number generator). The elevated and rising HbA1c values are purposefully constructed to fall within a range that would be considered meaningful but not critical. Doing so is intended to introduce a degree of deliberation and judgment into the decision-making process, as initiating insulin therapy is not the definitive answer. In this way, the elevated and rising HbA1c values, combined with the current medication and dosage data, convey that a dual OHA regimen has failed to achieved the ADA-recommended goal of HbA1c <7.0%, and that the VP should be considered for insulin therapy (ADA, 2016).



Ms. Martinez is a 60-year old female who presents to your clinic for follow-up. She was diagnosed with diabetes 6 years ago following an HbA1c reading of 7.6%. Ms. Hernandez has received counseling on lifestyle changes. She has no contraindications for common treatment options for diabetes, and she is open to all treatment options. Please see additional information below.

Face Sheet

Patient Name:	Martinez, F	**Ethnicity:**	Hispanic
Sex:	F	**Race:**	White
Age:	60	**Country of origin:**	United States
		Insurance:	Yes

Problem List

diabetes mellitus, type 2	active
hypertension	active
hyperlipidemia	active
osteoarthritis	active
overweight/obesity	active

Medication List

ACE inhibitor	10 mg	active
amlodipine	10 mg	active
atorvastatin	40 mg	active
metformin	2000 mg	active
sitagliptin	100 mg	active

Vital Signs

BP	*HR*	*RR*	*T(F)*	*BMI*
131/71 mmHG	74	12	98.6	28 kg/m^2

Completed Orders

LDL-cholesterol	*HbA1c*	*eGFR*
94 mg/dL	8.5%	75 mL/min/1.73m^2

Figure 1. A representative virtual patient profile used in the present study.

Providers' Diabetes Treatment Decisions

Below each profile and on the same screen, the following question was presented to providers: "How likely are you to take the following actions to manage this patient's diabetes?" Providers then moved a slider along the continuum of a visual analog scale (VAS) to rate their likelihood of performing each treatment decision: (1) "no additional action at this time, schedule follow-up in 3 months," (2) "add oral hypoglycemic agent," (3) "switch to/add basal insulin," and (4) "refer to an endocrinologist." Likelihood ratings for each treatment decision were obtained using separate VASs with benchmarks at *Extremely unlikely* (0), *Somewhat unlikely* (25), *Neither likely nor unlikely* (50), *Somewhat likely* (75), and *Extremely likely* (100). VASs are considered reliable, valid, and sensitive measures of subjective experiences (Gift, 1989) that are easy to use and thus decrease participant burden (Wewers & Lowe, 1990). Directly below the four VASs, the following question was presented to providers: "Given the above, would you perform the following actions?" The same four treatment decisions were presented alongside yes/no radio buttons, thus producing dichotomous treatment decision outcomes that mimic clinical practice (e.g., whether a provider actually refers to an endocrinologist or not). Therefore, providers make a total of eight treatment decisions per VP (four treatment decisions as continuously measured VAS ratings and four as dichotomously measured yes/no outcomes).

Demographics

Providers reported their age (years), sex (0=male, 1=female), race/ethnicity, and place of birth. Providers indicated race/ethnicity by selecting one of the following: American Indian or Alaska Native, Asian, Black or African American, Hispanic or Latino, White, or Other/Multi-Racial. Providers were asked whether they were born in the U.S. (yes/no).

Training Status and Experience. Providers reported their training status (medical student, resident, or fellow) and year within that status. Providers were asked to rate their experience with diabetes care using a VAS ranging from *Not at all experienced* (0) to *Very experienced* (100) and their likelihood of practicing primary care in the future using a VAS ranging from *Not at all likely* (0) to *Very likely* (100).

Data Analysis

All analyses were conducted using SPSS version 25.0 (IBM, Chicago, IL) and with alpha level=0.05. We first summarized provider characteristics using descriptive statistics. Then, following lens model design methodology, we ran a series of traditional group-level (nomothetic) and individual-level (idiographic) analyses to estimate the effects of patient immigrant status on provider diabetes treatment decisions.

Nomothetic Analyses

We first examined the influence of patient immigrant status on the decision to take no action at the traditional group-level of analysis in four steps. First, for each provider, we calculated the mean VAS ratings for taking no action at each level of the immigrant status cue (Mexico-born, U.S.-born). To calculate the first mean VAS rating, we averaged across the four VAS ratings for taking no action associated with the Mexico-born VPs, and repeated this with the four VAS ratings associated with the U.S.-born VPs to create the second mean VAS rating. This created 280 mean VAS ratings for taking no action (140 ratings for Mexico-born VPs and 140 ratings for U.S.-born VPs). Second, we conducted a dependent samples *t*-test involving the entire sample to compare the mean Mexico-born VAS rating to the mean U.S.-born VAS ratings. Third, we calculated Cohen's d_z to quantify the effect size for the influence of patient immigrant status on the decision to take no action. Finally, dichotomous treatment decisions were analyzed using the Durkalski-adjusted McNemar test. The McNemar test is commonly used for analyzing repeated measures data with dichotomous outcomes (e.g., pre-post test with a dichotomous outcome). The McNemar test assumes independence among the repeated responses. In the present study, each provider repeated four dichotomous treatment decisions at each level of patient immigrant status. Because the independence assumption is violated (i.e., the four repeated decisions at each level of immigrant status are correlated), the McNemar test may underestimate the standard error. To address this violation, Durkalski and her colleagues (2003) proposed an adjusted McNemar test for analyses of clustered repeated measures data. The null hypothesis is that the two marginal probabilities are the same. Analyses were conducted in R (version 3.6.1) using the "clust.bin.pair" package and Durkalski method.

Idiographic Analyses

Because each provider becomes his or her own sample in idiographic analysis, we constructed 140 separate datasets – one for each provider. Each dataset contained 32 observations consisting of four continuously measured treatment decisions for each of the eight VPs. Of note, we did not conduct idiographic analyses for the dichotomously measured treatment decisions due to low cell counts. To examine the influence of patient immigrant status on the decision to take no action within each dataset (provider), we conducted an independent samples *t*-test by entering immigrant status (0=U.S.-born, 1=Mexico-born) as the predictor and VAS ratings to take no action for the eight VPs as the outcome. We then calculated Cohen's *d* to capture the effect size for the influence of patient immigrant status on the decision to take no action within each dataset. We repeated this process for the remaining treatment decisions of adding an OHA, adding/switching to insulin, and referring to an endocrinologist. Due to the low number of observations used in each *t*-test (i.e., eight), analyses are underpowered to detect meaningful differences between Mexico-born and U.S.-born VPs. Thus, we report the effect sizes (Cohen's *d*) for the influence of patient immigrant status on each provider treatment decision. We considered effect sizes ≥0.50 (medium to large effect and greater [Cohen, 2013]) to indicate potentially meaningful differences. After calculating four effect sizes per dataset, we re-combined across all 140 datasets, resulting in 560 individual effect sizes. We then conducted frequency analyses to characterize idiographic results by effect size (d = 0.00-0.49: no to small effect, d = 0.50-0.79: medium to large effect, $d \geq 0.80$: large effect) and direction of effect (how many of those effect sizes indicated a higher treatment ratings for Mexico-born VPs). We also calculated the mean difference in VAS ratings for each of the four treatment ratings between Mexico-born and U.S.-born VPs at each level of effect size.

RESULTS

Provider Characteristics

As is shown in Table 1, the mean age of providers was 25 years (range: 21-35 years), and the majority (58%) were female. The sample was predominantly Asian (43%) or White (41%) and born in the U.S. (83%). The vast majority (95%) were also current medical students. Providers' average self-rated experience with diabetes care was 38 out of 100 (range: 0-89), and providers' average self-rated likelihood of practicing primary care in the future was 42 out of 100 (range: 0-100). Of 134 (96%) guesses at study purpose, only four (3%) included any mention of patient immigrant status.

Table 1. Characteristics of Providers (N=140)

Age (years), mean (*SD*)[a]	25.4 (2.1)
Female, *n* (%)	81 (57.9)
Race/Ethnicity, *n* (%)	
Non-Hispanic Asian	60 (42.9)
Non-Hispanic White	58 (41.4)
Non-Hispanic Black	9 (6.4)
Hispanic/Latino	7 (5.0)
Other/Multi-Racial	6 (4.3)
Immigrant Status, *n* (%)[b]	
U.S.-born, excluding U.S. Territories	116 (82.9)
Foreign-born	23 (16.4)
Training Status, *n* (%)	
Medical Student	133 (95.0)
First-Year Medical Resident	7 (5.0)
Current Year in Medical School, *n* (%)[c]	
First Year	15 (10.7)
Second Year	17 (12.1)
Third Year	66 (47.1)
Fourth Year	35 (25.0)
Self-Rated Experience with Diabetes Care (0-100), mean (*SD*)	37.8 (19.1)
Self-Rated Likelihood of Practicing Primary Care (0-100), mean (*SD*)	41.9 (29.4)

[a]From 137 participants with age data. [b]From 139 participants with immigrant status data. [c]From 133 participants currently enrolled in medical school.

Nomothetic Analyses: Influence of Patient Immigrant Status on Provider Diabetes Treatment Decisions at the Group Level

Nomothetic analyses tested for group-level differences in treatment decisions between Mexico-born and U.S.-born VPs. For continuous VAS treatment ratings (see Table 2), providers indicated the greatest likelihood of adding/switching to insulin (mean VAS rating of 60 for both groups), followed by adding an OHA (mean VAS rating of 54 for both groups). Providers gave numerically higher ratings for taking no action and numerically lower ratings for referring to an endocrinologist to Mexico-born versus U.S.-born VPs (means of 26 vs. 24 for taking no action and 20 vs. 32 for referring to endocrinology, respectively). Dependent samples *t*-tests involving the continuous VAS treatment decision variables indicated that there were no significant differences between Mexico-born and U.S.-born VPs in treatment ratings for taking no action, adding an OHA, and adding/switching to insulin (all ps ≥ 0.10). However, providers gave significantly lower ratings for referring to an endocrinologist to Mexico-born versus U.S.-born VPs (p=0.03). The effect size for this difference (d_z=-0.18) is in the small range (Cohen, 2013).

For dichotomous treatment decisions, most providers endorsed adding/switching to insulin (60% for both groups), and the fewest endorsed taking no action (13% for both groups). A numerically higher percentage of providers endorsed adding an OHA for Mexico-born VPs versus U.S.-born VPs (53% vs. 51%, respectively), while a numerically higher percentage of providers endorsed referring to an endocrinologist for U.S.-born VPs versus Mexico-born VPs (35% vs. 30%, respectively). As seen in Table 2, the pattern of results from analyses using dichotomous treatment decisions were consistent to those using continuous VAS treatment ratings. Results from the Durkalski-adjusted McNemar test showed no significant differences between Mexico-born and U.S.-born VPs in dichotomously measured treatment decisions to take no action, add an OHA, or add/switch to insulin (all ps > 0.20). However, providers were significantly less likely to endorse referring to an endocrinologist for Mexico-born vs. U.S.-born VPs (Durkalski-adjusted χ^2=9.2, p=0.002). Because the clust.bin.pair R package does not produce an odds ratio-equivalent statistic, no effect sizes were calculated for the influence of patient immigrant status on dichotomous treatment decisions.

Table 2. Results of Nomothetic (Group-Level) Analyses Comparing Provider Diabetes Treatment Decisions for Mexico-Born and U.S.-Born Virtual Patients

	Mexico-Born Virtual Patients	**U.S.-Born Virtual Patients**		
Continuous Treatment Decisions (0-100 VAS)	*Mean (SD)*	*Mean (SD)*	*Cohen's d_z*[a]	*p-value*
Take No Action	25.5 (22.4)	23.7 (21.1)	0.14	0.10
Add an OHA	53.9 (23.2)	54.4 (24.0)	-0.04	0.62
Add/Switch to Insulin	59.8 (22.2)	60.0 (22.8)	-0.02	0.75
Refer to Endocrinologist	20.0 (27.9)	32.1 (28.5)	-0.18	0.03
Dichotomous Treatment Decisions (Yes/No)	*Frequency Yes (%)*[b]		*χ^2*[c]	*p-value*
Take No Action	72 (12.8%)	70 (12.5%)	0.0	1.00
Add an OHA	296 (52.9%)	284 (50.7%)	1.5	0.22
Add/Switch to Insulin	338 (60.4%)	338 (60.4%)	0.0	1.00
Refer to Endocrinologist	168 (30.0%)	197 (35.2%)	9.2	0.002

Note. VAS, visual analog scale; SD, standard deviation; OHA, oral hypoglycemic agent. [a]Cohen's d_z is an effect size used to indicate the standardized difference between two means in a repeated-measures design. Cohen's d_z = 0.00-0.49 indicates a small effect size; d_z = 0.50-0.79 indicates a medium effect size; d_z = 0.80+ indicates a large effect size. [b]Percentage of 560 observations (4 decisions x 140 providers). [c]Durkalski-adjusted McNemar's χ^2.

Idiographic Analyses: Influence of Patient Immigrant Status on Provider Diabetes Treatment Decisions at the Individual Level

Idiographic analyses examined the degree to which individual providers used the immigrant status cue in their treatment decisions. As seen in Table 3, frequency analyses indicate that patient immigrant status influenced the treatment decisions of many providers, and further, that the magnitude and direction of this influence varied across providers.

The results revealed an approximate even split between providers giving higher treatment ratings to Mexico-born VPs and providers giving higher treatment ratings to U.S.-born VPs for decisions to take no action, add an OHA, and add/switch to insulin (Table 3). First, for taking no action, 61 (44%) providers were classified as giving meaningfully different ratings (i.e., $d \geq 0.5$) for Mexico-born and U.S.-born VPs. Of these 61 providers, 34 (24%) gave higher ratings for taking no action for Mexico-born VPs, while the remaining 27 (19%) gave higher ratings for U.S.-born VPs. Second, for adding an OHA, 70 (50%) providers gave meaningfully different ratings, with 33 (24%) giving higher ratings to Mexico-born VPs, and 37 (26%) giving higher ratings to U.S.-born VPs. Third, for adding/switching to insulin, 72 (51%) providers gave meaningfully different ratings – 39 (28%) gave higher ratings to Mexico-born VPs, and 33 (24%) gave higher ratings to U.S.-born VPs.

The pattern of results for referring to an endocrinologist differed somewhat from the other three decisions, in that direction was not as evenly split. Of the 66 (47%) providers who gave meaningfully different ratings, 26 (19%) gave higher ratings for referring to an endocrinologist to Mexico-born VPs, whereas 40 (29%) providers gave higher ratings to U.S.-born VPs. Notably, across all four treatment decisions, effect sizes were large (i.e., $d \geq 0.80$) for a considerable number of providers. Specifically, the effect size was large for 22% of providers for taking no action, 25% of providers for adding an OHA, 30% of providers for adding/switching to insulin, and 34% of providers for referring to an endocrinologist.

Overall, the pattern of results from idiographic analyses indicate that (a) about half of providers were meaningfully influenced by the immigrant status cue and that (b) over a quarter used the cue heavily in decision-making. Importantly, the pattern of results also indicates that the cue led to decisions in opposing directions, which explains why significant differences for three of the ratings were not observed at the group level (i.e., they were cancelled out).

Table 3. Results of Idiographic (Individual-Level) Analyses Characterized by Frequency and Direction of Effect Sizes for the Influence of Virtual Patient Immigrant Status on Continuous Provider Diabetes Treatment Decisions

Treatment Decisions	*Effect Size Range*	*Higher to Mexico-Born Virtual Patients*	*No Difference*	*Higher to U.S.-Born Virtual Patients*
		%	%	%
Take No Action	*d* = 0.00-0.49	-	55.7	-
	d = 0.50-0.79	10.0	-	12.1
	d = 0.80+	14.3	-	7.9
Add an OHA	*d* = 0.00-0.49	-	50.0	-
	d = 0.50-0.79	9.3	-	13.6
	d = 0.80+	14.3	-	12.9
Add/Switch to Insulin	*d* = 0.00-0.49	-	48.6	-
	d = 0.50-0.79	10.0	-	11.4
	d = 0.80+	17.9	-	12.1
Refer to Endocrinologist	*d* = 0.00-0.49	-	52.9	-
	d = 0.50-0.79	11.4	-	12.1
	d = 0.80+	7.1	-	16.4

Note. *d* = 0.00-0.49 indicates a small effect size; *d* = 0.50-0.79 indicates a medium effect size; *d* = 0.80+ indicates a large effect size. OHA, oral hypoglycemic agent.

CONCLUSIONS

The purpose of this experimental study was to estimate the effect of patient immigrant status on providers' diabetes treatment decisions. Unique aspects of this study were the use of virtual patient technology, which capitalizes on experimental control, and the use of lens model methodology, which models effects at both the nomothetic (group) and idiographic (individual) levels. Such modeling yields two sets of distinct but complementary results that promote a more complete understanding of how immigrant status influences provider treatment decisions.

Nomothetic (group-level) results indicate that VP immigrant status influenced one of the four treatment decisions examined. Specifically, providers gave significantly lower ratings for referring to an endocrinologist to Mexico-born VPs than to U.S.-born VPs. Although not one of the primary decisions of interest here, the potential implications of immigrant status differences in referral rates are intriguing. In particular, decreased endocrinology referral rates for foreign-born versus U.S.-born patients with diabetes may be one mechanism by which immigrant status is associated with lower odds of insulin treatment detected in prior work (Hsueh et al., 2018). Other literature examining provider specialist referral behaviors for immigrant patients is lacking. However, it is possible that providers hold beliefs that, due to cultural or language differences, foreign-born patients are less likely to follow-up with a specialist referral. Indeed, considerable evidence documents the ways in which provider beliefs about and expectations of their patients influence medical decision-making. For example, van Ryn and colleagues (2006) found that providers who held unfounded beliefs that their Black patients were less educated than their White patients were less likely to refer their Black patients for coronary artery bypass graft surgery, despite clear clinical indications to do so. Future work should examine the potential causes (e.g., provider beliefs) and consequences (e.g., suboptimal blood glucose control) of lower referral rates to endocrinologists or other specialists for foreign-born patients.

In contrast, VP immigrant status did not influence provider decisions to take no action, add an OHA, and add/switch to insulin. The pattern of results at the group level for our two primary outcomes of interest (adding an OHA and adding/switching to insulin) are partially consistent with the extant literature. Our prior epidemiologic work (Hsueh et al., 2018) examining differences in pharmacological treatment for diabetes across immigrant status showed that being foreign-born versus U.S.-born was not associated with treatment with OHAs, a pattern

also found here. That same study showed that being foreign-born was associated with 47% lower odds of treatment with insulin, a relationship not observed here. This lack of an effect of patient immigrant status on the likelihood of adding or switching to insulin warrants further investigation. First, insulin is a particularly cost-prohibitive treatment (Xinyang et al., 2019), and those without insurance are especially hard hit by the rising cost of insulin. In the present study, the vignette explicitly stated that the patient had insurance coverage, which may have neutralized provider concerns over the potential financial burden of prescribing insulin and reduced immigrant status differences. Nonetheless, because foreign-born individuals remain less likely to be covered by health insurance (Boyd, Leah, Danny, & Wesley, 2018), future research should investigate a potential immigrant status by health insurance status interaction effect on provider treatment decisions. Second, initiating insulin therapy requires effective patient-provider communication (Ng, Lai, Lee, Azmi, & Teo, 2015). Importantly, approximately half of the foreign-born population has limited English proficiency (Lopez & Radford, 2017), and patients with limited English proficiency tend to have less effective communication with their providers (Karliner et al., 2012; Morales, Cunningham, Brown, Liu, & Hays, 1999; Wilson, Chen, Grumbach, Wang, & Fernandez, 2005). Over and above actual English proficiency, non-native accents may exert an outsized influence on clinical interactions. In the case of Mexican-origin immigrants, Spanish-accented speakers are often stigmatized (Dovidio, Gluszek, John, Ditlmann, & Lagunes, 2010) as being low in competence (Hosoda et al., 2012), and invoking this stereotype may exert undue influence on provider treatment decisions that necessarily involve patient self-management, such as insulin. These language cues were missing in the present study, which may have reduced the potency of the immigrant status cue in provider decisions to add or switch to insulin. Investigating the potential role of patient limited English proficiency and non-native accent on the insulin initiation process could clarify the roles of these potential mechanisms. We especially encourage the use of VP designs to examine aspects of speech in future work.

One possible conclusion drawn from our nomothetic (group-level) results is that few providers used the immigrant status cue in making three of the four treatment decisions. However, our idiographic (individual-level) results demonstrate that such a conclusion would be incorrect, as many providers did indeed use the immigrant status cue. Specifically, for each of the four treatment decisions, we found that approximately half of the providers meaningfully

used the immigrant status cue. Moreover, over a quarter of providers used the cue heavily in decision-making.

Critically, for three of the treatment decisions (taking no action, adding an OHA, and adding/switching to insulin), provider decision ratings were about evenly split between being higher for Mexico-born VPs or being higher for U.S.-born VPs. This pattern of results explains why the effect for VP immigrant status on these three decisions was not observed at the group level as it was for the decision to refer to an endocrinologist. It is not the case that patient immigrant status was meaningful to providers only when it came to decisions to refer to an endocrinologist. Rather, in decisions to refer to an endocrinologist, providers as a group moved more consistently in the direction of giving higher ratings to U.S.-born VPs. In contrast, providers that were influenced by immigrant status in their decisions to take no action, add an OHA, or add/switch to insulin, split into two approximately equal groups, which worked against one another to mask effects at the nomothetic (group) level. This second, more complete interpretation of the results leads to an altogether different understanding of how patient immigrant status influences provider decision-making: almost half of all providers meaningfully used patient immigrant status when making clinical decisions. As is the case with race (A. T. Hirsh, Callander, & Robinson, 2011; A. T. Hirsh, George, & Robinson, 2009; A. T. Hirsh et al., 2015; Stutts et al., 2010), the effects of immigrant status are nuanced but the potential consequences are important. Medical decision-making will always be a complex and dynamic process and providers will always have to judge the clinical utility of multiple valid cues. However, systematic differences in treatment based on non-relevant, non-clinical factors could lead to unintended adverse outcomes for the foreign-born population living in the U.S.

Potential mechanisms underlying why immigrant status' influence on provider treatment decisions manifested in opposing directions are worth considering. Given that this is the first study to examine immigrant status differences in diabetes-related treatment decisions at the idiographic level, comparisons with the extant literature are not yet possible. However, this pattern of directional variability at the idiographic level is well-documented in the context of pain. In these studies, directional variability in individual providers' pain-related decisions based on patient race (Black vs. White) and gender (male vs. female) is the norm (A. T. Hirsh et al., 2011; A. T. Hirsh et al., 2009; A. T. Hirsh et al., 2015; Stutts et al., 2010), although in some investigations, there was a trend toward one decisional direction (e.g., nurses tended to rate

females as having more negative pain-related mood [A. T. Hirsh et al., 2011]). In the present study, differences in providers' experiential knowledge may partially explain immigrant status' differential influence. Experiential knowledge, which is gained through prior encounters, shapes provider beliefs and behaviors (Brush Jr, Sherbino, & Norman, 2017). For example, in a study of medical students, hearing negative comments from attending physicians or residents about African American patients and having unfavorable contact with African American physicians were predictors of implicit racial bias (van Ryn et al., 2015). Future work should assess for providers' prior experience with, and affective experience of, managing the health of immigrant patients. Another similar but distinct mechanism that may be at play are differences in provider-held stereotypes. Stereotypes, unlike experiential knowledge, can be formed a priori. Stereotypes are culturally-held and transmitted. Providers, like all humans, are susceptible to using stereotypes to guide behaviors. Differences in the direction of immigrant status' influence may be attributed to negatively-held stereotypes, such as those that suggest certain immigrants are untrustworthy (Lee & Fiske, 2006). At the same time, awareness of such stereotypes may motivate people to overcompensate due to concerns of appearing prejudiced (Dovidio & Gaertner, 1998). Overcompensating could in turn result in an imbalance in treatment decisions across Mexico-born and U.S.-born VPs, albeit one in the direction of favoring the foreign-born. Whichever the case, it is worthwhile to investigate the potential role of immigrant stereotyping in medical care. Immigrants and their children are projected to account for 88% of U.S. population growth through 2065 (Pew Research Center, 2019), meaning and the health and wellbeing of this growing population will play an increasingly large role in shaping U.S. public health.

Some limitations of the present study are worth noting. First, although the use of a VP design has increased ecological validity over other experimental designs (e.g., paper-and-pencil vignette studies), we acknowledge that any experimental design may over-control for factors that are relevant in real-world clinical interactions. For example, immigrant status may serve as a proxy for factors that justifiably influence treatment decisions, such as health insurance coverage and engagement with the healthcare system. These factors, which are often confounded with patient immigrant status, are controlled for in this experimental design. Even so, it is striking that immigrant status emerged as an influential factor in treatment decisions, absent of such justifiable factors. Second, to achieve reliability within providers' treatment ratings while managing participant burden, each provider was exposed to only eight VPs. Consequently, the

idiographic analyses were underpowered. Nonetheless, the pattern and magnitude of effect sizes observed in the idiographic analyses are compelling, and future work with increased number of patient profiles per provider to examine statistically significant differences at the idiographic level are warranted. Finally, our results from this sample of physician-trainees may not generalize to physicians with extensive experience in primary care or diabetes care specifically. However, this study was intentional in targeting physician-trainees: the 90,000+ trainees currently delivering patient care in the U.S. (Association of American Medical Colleges, 2016) are developing cognitive habits that crystallize into decision-making heuristics (Brush Jr et al., 2017) that will persist even as they gain further skills in clinical reasoning (Ledford, Seehusen, Chessman, & Shokar, 2015). Moreover, each trainee will become responsible for managing the care of thousands of patients over the course of their medical career.

This study is the first to empirically test one potential mechanism (provider therapeutic inertia) underlying the differences in diabetes outcomes across immigrant status found in observational studies. By precisely characterizing the influence of patient immigrant status on provider diabetes treatment decisions, we strengthen the scientific rationale for targeting provider behaviors via intervention. Notably, a recently completed NIH-funded randomized controlled trial testing a perspective-taking intervention to reduce race and SES disparities in pain care (Hirsh et al., 2019) demonstrates the effectiveness of intervening on provider behaviors by using the same methodological approaches of the current study. That trial used a VP design and idiographic approach (through real-time statistical analyses of provider treatment decisions, followed by immediate feedback on any detected treatment biases) to tailor the perspective-taking intervention to the needs of each individual provider. Providers randomized to the tailored intervention (vs. control) demonstrated a 76% (for SES) to 85% (for race) lower odds of demonstrating bias for Black and low SES patients after completing the personalized feedback and perspective-taking intervention. Those positive trial results, combined with evidence for the influence of immigrant status on provider treatment decisions from the current study, suggest that applying the same paradigm in the context of immigrant disparities in diabetes care could be an effective method for reducing unintended differences in care to immigrant patients, and thereby reducing downstream consequences of unequal care, such as patient disengagement, diabetes-related complications, and mortality.

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