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Racial inequities in receipt of influenza immunization among U.S. nursing home residents

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Racial inequities in receipt of influenza immunization among U.S. nursing home residents

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B.S. Florida State University, 1984
M.P.H. Emory University, 1994
M.A. Franciscan University, 2000

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An abstract of
A dissertation to the Faculty of the James T. Laney School of Graduate Studies of Emory University in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Epidemiology

2011

Abstract

Racial inequities in receipt of influenza immunization among U.S. nursing home residents

By Barbara Bardenheier

Two national studies reported a White-Black (W-B) difference in vaccination coverage of 8 percentage points among nursing home residents. In Michigan during the 2005-2006 influenza season, the W-B difference in vaccination exceeded 20 percentage points; the racial gap increased between facilities as proportions of Black residents in the facility increased. Studies among community-dwelling seniors have shown that less frail persons may seek the vaccine more; however, studies report inconsistent findings in the association of frailty and vaccination among nursing home residents *within* facilities. Use of standing order programs (SOPs) is an evidence-based approach to increase vaccination coverage among residents. Further, Blacks are less likely than Whites to live in nursing homes with SOPs. These findings lead to three questions that examine the relationship between race and receipt of the influenza vaccine among nursing home residents.

1. *Does frailty contribute to racial differences in reported receipt, refusal, or not being offered the influenza vaccine **within** nursing facilities in Michigan?*
2. *What factors contribute to the racial gap in vaccine offering **between** nursing facilities in Michigan?*
3. *Do racial composition of the facility, influential authorities and barriers to SOPs jointly contribute to the racial gap in receipt of vaccine **between** nursing facilities?*

In Michigan, frail residents of whichever race was in the minority in nursing homes had the highest adjusted probabilities of not being offered the vaccine. Facility characteristics that contributed to the variability in offering vaccine between homes include levels of staff resources, proportions of Blacks in the facility, and levels of severely ill patients. Facilities with larger proportions of Black residents were associated with perceived barriers (e.g., financial, legal, liability) to implementing SOPs. The states' Quality Improvement Organization and certification surveyor may play an important role in addressing misperceptions about staff's authority to vaccinate under SOPs and in educating physicians about the benefits of SOPs for influenza vaccination among nursing home residents.

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LIST OF ABBREVIATIONS

ACIP: Advisory Committee for Immunization Practices
ADL: Activity of daily living (dressing, transferring, eating, bathing, toileting)
CDC: Centers for Disease Control & Prevention
CMS: Centers for Medicare & Medicaid Services
HP2010: Healthy People 2010
IADL: Instrumental activity of daily living (not necessary for fundamental functioning, but enable the individual to live independently within a community. E.g., light housework, preparing meals, taking medications, shopping for groceries or clothes, using the telephone, managing money)
ILI: Influenza-like illness
IOM: Institute of Medicine
LTCF: Long-term care facility
MDS: Minimum Data Set (housed by CMS, includes all RAIs)
NF: Nursing facility
NHAP: Nursing home-acquired pneumonia
NNHS: National Nursing Home Survey
NQF: National Quality Forum (non-profit organization that promotes change through development and implementation of a national strategy for health care quality measurement and reporting)
OBRA Act of 1987: Omnibus Budget Reconciliation Act of 1987 (expanded requirements that nursing homes had to comply with prior to Medicare certification, altered the principles for enforcement, and defined the state survey and certification process for determining compliance with federal standards of care)
OSCAR: Online Survey and Certification Reporting System (administrative facility database)
PPS: Prospective payment system (method of reimbursement in which Medicare payment is made based on a predetermined, fixed amount)
PPV: Pneumococcal polysaccharide vaccine
QIO: Quality Improvement Organization (the quality assurance arms of CMS who conduct quality improvement activities in a variety of settings)
RAI: Resident Assessment Instrument
RUG: Resource utilization groups (Group (n=44) into which a nursing home resident is categorized, based on functional status and anticipated use of services and resources; used to determine reimbursement to the facility)
SNF: Skilled nursing facility
SOP: Standing order protocols

GLOSSARY

Black race: A person self-defined as being black race of non-Hispanic ethnicity according to the resident assessment instrument.

Clinical Frailty: The Minimum Data Set-Changes in Health, End-stage disease and Symptoms and Signs (MDS-CHESS) score is a composite measure focused on changes in health, end-stage disease, and symptoms and signs of medical problems.[1] The CHESS score has been found to be a strong predictor of mortality, independent of age, gender, cognitive impairment, physical impairment (ADLs), and do-not-resuscitate (DNR) orders.[1]

Cognitive Frailty: The MDS Cognitive Performance Scale (MDS-CPS) is based on 5 MDS items and classifies residents into 7 cognitive performance levels from 0 to 6[2] based on cognitive skills, from independent to severely impaired, for decision making.

Factor analysis: The purpose of factor analysis is to discover simple patterns in the relationships between variables. Specifically, it seeks to discover if the observed variables can be explained largely or entirely in terms of a much smaller number of unobserved variables called (latent) *factors*.[3] Exploratory factor analysis identifies such patterns in terms of factors that have not been previously established.

Long-term care: Broad definition of care that includes nursing homes (aka, nursing facilities), residential care, and assisted living.

Measurement model: This model, also known as confirmatory factor analysis, specifies the relationship of the latent factor to the observed variables. Typically this

model has been identified in exploratory factor analysis previously, but that is not required to conduct the confirmatory factor analysis.[4]

Minimum Data Set (MDS): Resident assessment instruments (RAI) conducted in all U.S. nursing homes certified by the Centers for Medicare & Medicaid Services (CMS), submitted to CMS. Resident assessments are administered at admission, quarterly, and for any significant change in condition for all residents in Medicare/Medicaid certified facilities. This data set includes only nursing homes (nursing facilities).

Physical frailty: The MDS Activities of Daily Living (ADL)—Long Form is a measure including 7 ADLs: 1) dressing; 2) personal hygiene; 3) toilet use; 4) locomotion on unit or how the resident moves between locations including rooms on the same floor; 5) transfer or how the resident moves between surfaces such as beds and chairs; 6) bed mobility or how the resident moves to and from the lying position; and 7) eating. [5] This measure indicates the level of need of assistance for various activities the patient requires on a daily basis.

Resource utilization groups (RUG): Groups (n=44) into which a nursing home resident is categorized, based on functional status and anticipated use of services and resources; used to determine reimbursement to the facility.

Structural equation model: This model specifies the relationships among the latent factors (variables).[4]

Two-tiered system: An artifact of the 'separate but equal' funding system. The lower tier consists of facilities housing mainly Medicaid residents and, as a result, has very limited resources. These homes have fewer nurses, lower occupancy rates, and more health-related deficiencies. They are more likely to be terminated from

the Medicare/Medicaid program, are disproportionately located in the poorest counties, and are more likely to serve Black residents than are other facilities.[6]

White race: A person self-defined as being white race, of non-Hispanic origin according to the resident assessment instrument.

INTRODUCTION

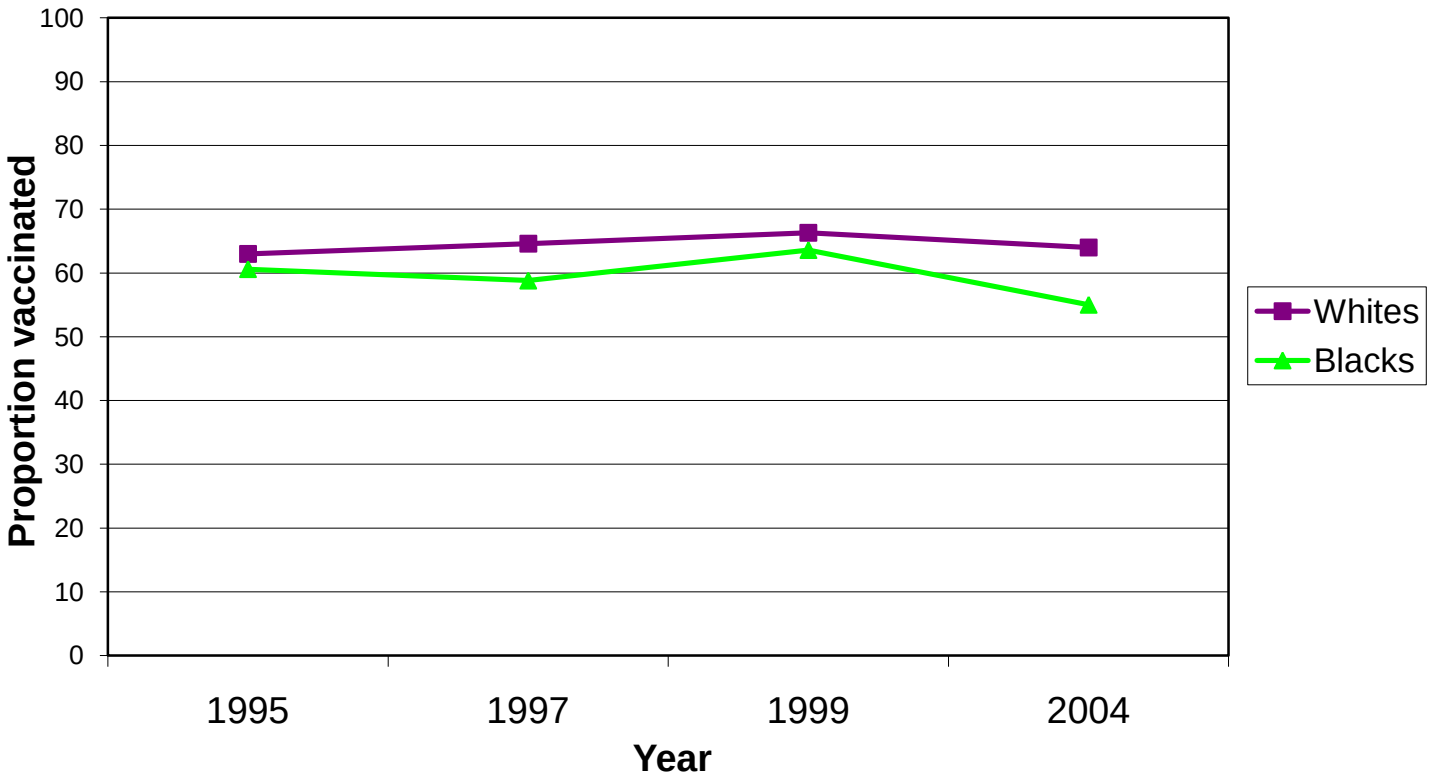
Race is a strong predictor of influenza vaccination among non-institutionalized seniors.[7,8] A demonstration project designed to increase influenza vaccination among *community-dwelling* seniors and to examine racial differences in uptake found that after controlling for confounders, racial disparities in influenza vaccination remained.[8] This study found that provider recommendation was strongly associated with vaccination status. Differences in provider recommendation could be partially due to documented variation in quality of care according to provider and practice characteristics,[9,10] which may differentially affect Black patients and which have been found to influence use of vaccination.[9] Since October 1, 2005 residents of nursing facilities certified by CMS (Center for Medicare & Medicaid Services) must be offered the influenza vaccine annually. Thus for residents of these facilities, documented variation in receipt of vaccination within a facility would likely be minimal. Therefore, if racial disparities in receipt of influenza vaccination within nursing facilities exist, factors particular to the racial composition of the facility and those at the individual level should be considered.

However, little has been done to examine the relationship of race and influenza vaccination status among U.S. nursing home residents. According to the National Nursing Home Survey (NNHS), a statistically significant racial inequity for influenza vaccination was found with a trend test from 1995 through 1999 (2 percentage point difference in 1995 and 1999 and 5 percentage point difference in 1997, $p<.01$).[11] In the 2004 NNHS, the White-Black difference widened; coverage among Whites remained stable but coverage among Blacks dropped significantly

(64.8% vs 55.6%)[11] [Figure I-1]. The striking change in the 2004 NNHS could be due to the difference in the way the question was asked; it was amended to respond affirmatively to vaccination if there was documentation. This 'artifact' theory is somewhat supported by a study we conducted in 14 states during the 2000-2001 influenza season that included over 21,000 nursing home residents' vaccination status from chart abstraction; we found an 8 percentage point disparity (Whites:59%, Blacks 51%, $p<.001$); however when stratifying on facility, the association was no longer significant ($p=0.15$),[12] suggesting the unadjusted association could be a type I error indicative of variation between facilities.[12] Also, when comparing results of models that did not account for correlation (i.e., logistic with independent correlation structure) to models that did (i.e., multilevel), we found the racial disparity in vaccination was most likely related to the infrastructure or factors at the facility and/or state level.[13] A statistical test for heteroskedasticity among residuals confirmed this. In fact, because of the positive correlation between race and receipt of the influenza vaccine the variance of the estimates was likely underestimated. Therefore it could be interpreted that the significant association found in the logistic model was a type I error.[14] However, a more appropriate interpretation of the logistic model is that a racial disparity in vaccination existed for the entire population. The fact that the association between race and receipt of vaccine was no longer significant when we controlled for the correlation did not necessarily mean no racial disparity in vaccination existed, but rather suggested that which facility the resident lived in was more strongly associated with getting vaccinated. This was confirmed by the multilevel model, which did not find a

significant association of race with receipt of immunization, likely due to control of the correlation between facilities (i.e., addition of a random term to the model) as well as confounding with the higher-level variable, the state in which the facility resided. This finding suggests that further research needs to be done to investigate if Blacks are more likely to refuse the vaccine or not to be offered the vaccine across facilities, or if they disproportionately live in homes with lower vaccination coverage, and if so, what factors are associated with the inequities.

Figure I-1. National Nursing Home Survey, 1995 – 2004: Influenza vaccination by race



DISSERTATION AIMS

This dissertation is motivated and organized around four questions.

1. Is frailty associated with the White-Black difference in receipt, offering, and refusal of influenza vaccination **within** nursing facilities in Michigan?

2. What factors in addition to racial composition of the nursing home contribute to the White-Black difference in vaccine offering **between** nursing facilities in Michigan?

3. Who are the influential authorizes in vaccination policy decision-making and what are the barriers to implementing standing orders for influenza vaccination?

    a. Are they related to each other and/or to the proportion of Black residents in the facility?

CHAPTER 1 INFLUENZA VACCINATION IN NURSING HOMES

Efficacy and effectiveness of the vaccine

Although a large number of influenza vaccine studies have been conducted among older populations, only one randomized trial has been reported. This study found that influenza vaccine reduced disease by 58% among persons aged 60 years and older without underlying health conditions.[15,16] Some studies have found influenza vaccine effectiveness in preventing medically attended acute respiratory illness among the elderly in nursing homes to be as low as 20%-40%,[17] while others found that vaccination can be up to 80% effective in preventing influenza death.[18,19]

Duration of immunity and protection

Adults aged ≥ 65 years typically have weakened immune response to influenza vaccination compared with young healthy adults, suggesting that immunity may be of shorter duration.[20] However there is no evidence that immunity declines more rapidly in the elderly.[21]

Vaccine delays and shortages

The annual supply of influenza vaccine and the timing of its distribution is a function of the private sector and cannot be guaranteed in any year.[22] Influenza vaccine supply steadily increased through the 1990's, but from 2000 to 2006, vaccine shipments were either partly delayed or diminished below projections in 4 of 6 years. Problems with influenza vaccine production had focused attention on vaccine manufacturing and distribution issues.[23] Since 2006 vaccine supply has been ample.

LONG TERM CARE SETTINGS

Aging population

The numbers and proportions of persons aged 65 years and older of diverse racial and ethnic origins in the United States are increasing. In 2005, 34,760,527 Americans were aged 65 years and older, 13.8% of whom were of diverse racial and ethnic origins (8.9% African-American). The proportion of minorities in the population in this age group is projected to increase rapidly; to 19.8% in 2010, to 24% in 2020 and to 41% in 2050.[24] Because the number and proportion of minorities in the older age groups is increasing, inequity of receipt in health care may not correct itself but may worsen unless policies are implemented to address the issues.

Healthcare workforce for long-term care

According to a recent IOM claim (April 2008), the education and training of the entire health care workforce with respect to the span of needs of older adults remains regrettably deficient.[25] Besides being inadequately prepared in geriatrics, the current workforce is not sufficient to meet older patients' needs, and the scarcity of workers specializing in the care of older adults is even more problematic.

With the current economic crisis, states are not likely to create more public healthcare providers as that would be more of a drain on Medicaid budgets.

FUNDING OF NURSING HOMES

Medicare

Medicare is the U.S. health insurance program for people age 65 or older. Certain people younger than age 65 can qualify for Medicare, too, including those

who have disabilities and those who have permanent kidney failure or amyotrophic lateral sclerosis (Lou Gehrig's disease). The program helps with the cost of health care, but it *does not cover all medical expenses or the cost of most long-term care*. (http://www.medicare.gov) Medicare is operated by the Centers for Medicare & Medicaid Services (CMS); in other words, it is run at the national level and is therefore uniform among beneficiaries, regardless of the state of residence. Medicare has four parts:

- Hospital insurance (Part A) that helps pay for inpatient care in a hospital or skilled nursing facility (following a hospital stay), some home health care and hospice care.
- Medical insurance (Part B) that helps pay for doctors' services and many other medical services and supplies that are not covered by hospital insurance.
- Medicare Advantage (Part C) plans are available in many areas. People with Medicare Parts A and B can choose to receive all of their health care services through one of these provider organizations under Part C.
- Prescription drug coverage (Part D) that helps pay for medications doctors prescribe for treatment.

Part A only pays if the patient is admitted to a skilled nursing facility (SNF) within 30 days of an inpatient hospital stay of $\geq$ 3 days; the patient's physician must certify that the patient requires skilled nursing care. Medicare only pays 100% for the first 20 days and the maximum it will pay anything is 100 days. After that, if the patient has private funds, those will cover; once the patient has 'spent-down,' he/she would have to apply for Medicaid and be eligible (i.e., exhausted one's assets and one's annual income to the medically needy levels to qualify). Part B pays for the annual influenza vaccine for all Medicare beneficiaries. That would typically include anyone over 65 and therefore approximately 95% of nursing home residents. Medicare would pay for medical services for a resident of a nursing home, but the monthly

living expenses would not be covered; also, custodial expenses, defined as non-medical costs for activities of daily living such as help with eating, transferring, dressing, and toileting would not be covered by Medicare. Monthly expenses, including 'rent' and custodial expenses are covered by most private insurance and Medicaid. It is also important to note that since the Balanced Budget Act of 1997, seniors have been paying increasingly higher annual premiums for Medicare parts A and B. It is pretty safe to assume that residents of nursing homes have some type of insurance to be living there; in other words, if they are Medicare beneficiaries, they are covered by part B that pays for the influenza vaccine. For the most indigent or those residents on Medicaid, Medicaid pays for the co-payments and premiums for Medicare.[26]

Medicaid

Unlike Medicare, which is operated at the national level, Medicaid is a federally-funded, *state-run* program that provides medical assistance for individuals and families with limited incomes and resources. Congress left it up to each state to define 'limited incomes and resources', ie, poverty. Medicaid eligibility therefore varies widely according to the political and economic environment of the state. The result is that, especially in states with weaker tax bases (e.g., southern states and rural states) Medicaid is available only to poorer residents than in other states. Further, it is important to note that Medicaid was established to provide care to the poor; it was not necessarily established to provide long term care for older persons.

States that do not have sufficient funds for long-term care may use Medicaid to fill the gap.[27] Again, this varies widely by state.

Nursing home residents who are insured by Medicaid typically have a daily per diem and this varies widely by state and is typically below the cost to the nursing home. So, cross-subsidization has historically helped in keeping an economically healthy mix of residents by insurance type. In fact, cross-subsidization has been as closely tied to nursing facility finances as to hospital finances.[6] Cross-subsidy can be explicit through cost shifting, that is, having enough profitable private-pay or Medicare residents to compensate for the Medicaid residents whose payments are rather low.

However, the Balanced Budget Refinement Act of 1999 brought about changes in Medicare's reimbursement policies that made cross-subsidization less likely. Prior to 1999, nursing homes were reimbursed by Medicare under a retrospective, widely accepted as reasonable, cost-based system. In 1999, the Medicare Prospective Payment System (PPS) for skilled nursing facilities (SNFs) was implemented nationally and changed reimbursements to facilities to a case mix-adjusted payment determined by assigning each patient to one of 44 resource utilization groups (RUGs) for care covered under Part A benefits. Among its provisions, PPS bundles all of Part A and B services for a Part A stay (ie, post-acute care) including medications, laboratory tests, supplies, and rehabilitation therapies into a single RUG payment, thereby placing nursing homes at financial risk for those services previously billed independently by outside vendors.[28] In other words, the

nursing home is reimbursed at a fixed cost well below what they had to pay the outside vendor. Because nursing facilities are reimbursed based on RUGS, this gives them incentive to keep current and timely in key-entering residents' assessments, as the RUG a patient is assigned to is determined from the information obtained from the RAI (Resident Assessment Instrument). The Minimum Data Set (MDS) contains the RAIs and is the dataset to be used for all subsequent analyses.

National trends of payment sources for nursing home residents using the National Nursing Home Survey, 1977-1999 found that Medicaid and private pay are the most traditional funding sources for nursing homes;[29] Medicaid continues to be the most important payment source for nursing home residents, suggesting that the government will be a key player in health care decisions involving the long-term care setting.

Private Pay

Before a long-term care resident can qualify for Medicaid, if not already a recipient, all personal assets must be exhausted. Thus payment from private funds is the second most common source of payment for residents of all ages.[29] In spite of its ongoing growth, private nursing home insurance still accounts for a relatively small percentage of nursing home usage.[30] What distinguishes buyers of long-term care (LTC) insurance is their wealth profile; they tend to have higher levels of income and assets. LTC insurance policies are evolving to be more comprehensive and more competitive. This market may well grow, because by 2011, the upper edge of the baby boom generation turns 65, beginning a retirement boom that will extend

through the next two decades. In the years prior to death, many of these people will need retirement income to pay for acute and long term care not covered by Medicare or Medicaid.

INFLUENZA AND PNEUMONIA IN NURSING HOME SETTINGS

Influenza and pneumonia among nursing home residents

In temperate climates such as in the United States, annual epidemics of influenza occur during the late fall through early spring seasons. Influenza viruses can cause disease among all age groups but the most severe cases of influenza illness and death occur in persons aged ≥ 65 years and among those who have medical conditions that place them at increased risk for complications from influenza.[31] From 1990 to 1999 an annual average of approximately 36,000 deaths occurred, 90% of them among persons aged ≥ 65 years. From 1979 to 2001, an annual average of approximately 226,000 hospitalizations was associated with influenza epidemics.[32,32] The risk of developing serious complications from influenza infection is elevated in older persons and also those with certain underlying conditions,[32-34] both of which are indicative of nursing home residents. Vaccination is the cornerstone of prevention; and every fall about 80 million people are vaccinated against influenza over a 2-3 month period in the United States.[35]

Chronic condition risk factors for influenza and pneumonia

The most common serious complications of influenza include exacerbation of underlying chronic pulmonary and cardiopulmonary diseases, such as chronic obstructive pulmonary disease, asthma, congestive heart failure, and development of bacterial pneumonia usually associated with *Streptococcus pneumoniae, Staphylococcus aureus*, or *Haemophilus influenzae*.[36] In 2002, an estimated 3,200 adults aged ≥ 65 years died as a result of invasive pneumococcal disease (Active Bacterial Core Surveillance data, Centers for Disease Control and Prevention (CDC)

unpublished, 2002). Nursing Home- Acquired Pneumonia (NHAP) is associated with substantial morbidity, healthcare expenses, and mortality rates as high as 44% among patients residing in long-term care facilities (LTCF).[37,38] LTCF residents infected with pneumococcal pneumonia are more likely to die and to be transferred to hospitals or acute care facilities than residents with other infections.[39,40] Emergency department visits and hospitalizations for nursing-home acquired infections are costly and associated with considerable disruption and relocation stress for residents,[41] may complicate existing and/or trigger new illnesses,[42] and may result in new or worsening pressure sores.[43] With the growth of the elderly population, immunization coverage among nursing home residents is becoming even more important for protecting this vulnerable population and to reducing consumption of limited resources.[44,45]

Transferring long-term care facility residents to hospitals for acute care

Hospitalizations of nursing home residents due to influenza or influenza-like-illnesses are expensive and expose residents to other iatrogenic disease and social and psychological harm.[41] Although the influenza vaccine is more efficacious in young, healthy adults than it is among institutionalized elders, vaccination does confer some protection against morbidity and mortality for this vulnerable population. The vaccine may therefore reduce the need for hospitalization of nursing home residents.

Residents returning to the facilities

When a patient leaves the hospital and enters the nursing home, typically a SNF or "skilled nursing facility" is preferred if available, as Medicare will pay for

nursing facility care which follows on a hospitalizations of 10 days or more; SNF care is preferable because the reimbursement is higher than that of NF or "nursing facility" care. (Joanne Lynn, unpublished) As soon as the patient needs little professional rehabilitation or complex medical management, Medicare's SNF payment stops. The payment then usually falls to private payments or Medicaid which is generally NF care. The vast majority of nursing facilities (72%) are certified for both Medicare and Medicaid (i.e., SNF and NF care) or are 'distinct part' (19%), meaning some beds in the facility are SNF and some are set aside to be NF, so most residents would not likely have to move to yet another facility after admission to the facility upon hospital discharge, unless they were admitted to a SNF-only home, which is only 3% of the CMS-certified facilities in the United States during 2005-2006.[46]

CHAPTER 2 VACCINATION REQUIREMENTS AND RECOMMENDATIONS

Vaccination Requirements

State immunization laws

Results of a study examining state laws and regulations that address the provision of immunizations recommended by the Advisory Committee on Immunization Practices (ACIP) to residents and/or staff of state-licensed long-term care facilities (LTC) found that 28 states had laws/regulations to control how LTC facilities must manage immunizations for residents and/or staff, and 23 jurisdictions do not have any relevant statutory requirements.[47]

State immunization laws for long-term care residents

Twenty-seven of the 28 states with immunization laws/regulations apply to residents of LTC facilities. Five states meet or exceed the Medicare/Medicaid conditions of participation (COP) for LTC facilities' residents, and 22 states satisfy the COP to varying degrees. The COP are: 1) assessing individuals to determine their immunization status, 2) providing individuals with education regarding vaccines, 3) implementing methods so individuals may refuse vaccines, 4) providing vaccines to all eligible persons, 5) adhering to the ACIP standard, and 6) maintaining appropriate documentation regarding immunization status for residents/staff.

Eighteen states require vaccines to be distributed to residents according to the standard outlined by the ACIP; the remaining 10 states detail which vaccines are required without reference to the ACIP. Sixteen of the 28 states require LTC facilities to actually *provide* vaccines to residents. The remaining 12 states that have

pertinent laws vary in how they describe the requirement to distribute vaccines to residents.

State immunization laws for healthcare workers of long-term care facilities

Fourteen of the 28 states with laws/regulations apply to employees of LTC facilities. No state meets all COP for employees, and the 14 states that apply to staff satisfy various elements of the COP. Eight of the 14 states with laws that apply to employees require facilities to *provide* selected vaccines to staff. The remaining six states vary in how they describe the distribution of vaccine.

Vaccination Recommendations

ACIP Recommendations

In 1964, the Advisory Committee for Immunization Practices (ACIP) was chartered, and the first recommendations for the influenza vaccine for those aged 65 years and older as well as for those with chronic medical conditions were for the 1965-1966 season. In 1988 a specific recommendation for those living in long-term care facilities was added.[48]

Healthy People 2010 immunization coverage goals

In 1994 the Healthy People 2000 objectives set a national goal of 80% (the national 2010 and 2020 goals are 90%)[49] influenza immunization coverage for institutionalized chronically ill people and older people.[50]

CMS requirements for certification

On October 1 2005, the Centers for Medicare & Medicaid Services (CMS) mandated that nursing homes certified by CMS must offer nursing home residents the influenza vaccine annually as a condition for maintaining certification. As a

consequence, when CMS revised the resident assessment instrument (RAI) to add a supplement for resident vaccination status, they considered leaving no option for 'undetermined or unknown vaccination status.' However, because they did not want to force nursing homes to incriminate themselves by responding that they had not offered residents the vaccine, they allowed an option for 'undetermined or unknown vaccination status.' (personal communication, Craig Hales, CMS)

NQF adds immunization as quality indicator

The OBRA Act of 1987 did not include immunizations as a quality indicator. In 2004, the National Quality Forum included vaccination as one of 11 standards for assessing quality of care in nursing homes.[51] Several pneumococcal outbreaks in nursing homes occurred in the 1990's and as a result, in 1997, the ACIP recommended PPV for nursing home residents. It is unclear why the influenza vaccine was not originally included as a quality indicator. Nevertheless, influenza vaccination is an important indicator of quality, so it can also be used to assess racial inequity in quality.

Summary of what should be done in nursing facilities

Although the ACIP recommends the influenza vaccine annually for all LTC facility residents and CMS requires that nursing facilities offer the vaccine to all its residents as a condition for certification, national vaccination coverage (2004 NNHS: 63.0%; 2005-2006 MDS: 62.3%) remains well below the Healthy People 2010 goal of 90%. Further, a racial gap of 8 percentage points between White and Black nursing home residents has been reported.[11,12,52] Vaccination policies should be implemented to increase coverage for *all* LTCF residents.

Existing Vaccination Policies in Nursing Facilities

Standing order protocols for immunizations

Reviews by the Task Force for Community Preventive Services[53] and the Southern California Evidence-Based Practice Center-RAND[54] have shown that standing order protocols (SOPs) improve vaccination levels; several studies have shown SOP effectiveness specifically in long term care facilities and hospitals.[55-57] SOPs authorize nurses and pharmacists, where allowed by state and institution policies, to administer vaccinations according to an approved protocol without the need for a physician's examination or direct order. In April of 1999, the Advisory Committee on Immunization Practices (ACIP) recommended that nursing homes implement SOPs for vaccinating residents against influenza and pneumococcal diseases. In homes where SOPs are implemented, racial disparities in vaccination coverage due to decisions of individual physicians could be eliminated. Unfortunately information on SOPs is not collected in the OSCAR reporting system. According to the most recent national survey of nursing homes (NNHS 2004) the association of race and residing in homes with standing orders for immunization is marginally significant (White 41.9% (CI 38.6-45.4); Black 37.9% (CI 31.3-44.9); Hispanic 42.5% (CI 31.8-54.0); Other 24.2% (CI 14.0-38.6); p=0.065 CDC, unpublished).

How effectively standing orders for immunizations are implemented is not well-publicized. Studies examining the effectiveness of standing orders vary in how strongly they are positively associated with vaccination coverage by type of setting. For example, one study found standing orders to be highly ineffective among

hospital patients.[58] Another study found use of standing orders for influenza vaccination in multispecialty clinics to be highly associated with increased vaccination coverage among pregnant women and healthcare workers.[59] A study examining use of standing orders for influenza vaccination of children in ambulatory clinics found no association with vaccination coverage.[60] Studies examining the association between use of standing orders for influenza vaccination and vaccination coverage among nursing home residents are inconsistent.[61,62]

Written vaccination policies

Facilities have various written vaccination policies, including, but not limited to: 1) Assessing vaccination history of the resident; 2) Informing the resident about the risks and benefits of the influenza vaccine; 3) Requiring consent of the resident for the influenza vaccine (either written or oral); 4) Requiring documentation if the resident or guardian refuses the influenza vaccine; 5) Requiring the resident be assessed for medical contraindications of the influenza vaccine; 6) Designating type of orders needed to authorize vaccination (e.g., standing orders, pre-printed admission order, etc.); 7) Administering vaccine by appropriate route (intramuscular, oral, nasal etc.); 8) Documenting immunization given; and 9) Observing for adverse side effects, once immunized. In our demonstration project conducted 1999-2002, adoption of written protocol alone was not significantly associated with a 10% increase in influenza vaccination coverage.[63]

Verbal consent allowed

Facilities with more demanding consent requirements for the influenza vaccine (i.e. written consent as opposed to oral consent) have been found to have

lower vaccination coverage.[63] Only one state requires written consent for the influenza vaccine (Maryland).[64] Misinterpretation of two federal acts regarding consent and vaccination, unrelated to immunization of adults for influenza and pneumococcal vaccines, might have caused some confusion in the past.[64] In 2005, the American Medical Directors Association revised its tool kit for vaccination by removing the sample signed consent form.[65] During the influenza vaccination season prior to this revision, residents in homes that allowed verbal consent had a slightly higher level of vaccination than residents of homes that did not allow verbal consent (64.9% vs 63.2%, NS).[62] Also, as a result of our demonstration project from 1999-2002, adoption of policy allowing verbal consent was significantly associated with an increase of at least 10% in influenza vaccination coverage (n=44 vs n=17 LTCFS, p=.01).[63]

Centralized tracking systems for immunizations

A centralized tracking system maintains records so that residents' vaccination status can be reviewed periodically to make sure they receive the vaccine if they were not known to be vaccinated upon admission. This type of system is also useful to determine immunization coverage for the home as a quality of care indicator and for feedback to staff to ensure optimal coverage. Approximately 40% of nursing homes have this type of policy, yet the vaccination coverage for residents of these homes is not significantly higher than vaccination coverage for residents of homes that do not have this type of policy (64.8% vs 63.3%).[62]

In our demonstration project, facilities that adopted a centralized tracking system for pneumococcal immunizations were significantly more likely to have ≥ 10 percentage point increase in coverage than facilities that did not adopt such a system.[63] Although this finding was not significant for the influenza vaccine, possibly due to differences in timing of administration of the vaccines, it can confound the relationship between race and receipt of vaccine because improved tracking has the potential to artificially increase immunization coverage through better documentation (i.e., ethnic/racial minorities may be more likely to live in homes with poor documentation).

Immunization of healthcare workers

The Advisory Committee for Immunization Practices (ACIP) recommends influenza vaccinations for all health care workers and others in close contact with persons at high risk;[66] the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requires that all long-term care facilities (LTCF) offer staff members influenza vaccination.[67] Despite the recommendation and requirement, only about 40% of LTCF staff receives the influenza vaccine.[68-70]

Healthcare workers can be a potential source of exposure of influenza disease to the residents they serve. One study found that healthcare workers in nursing homes in southern California did not have "sick time" and so would not be paid if they could not work due to illness. Therefore, they worked when they were sick and did not worry about infecting residents. (Kimura, et al, unpublished)

Facility recommendations of immunization for its healthcare workers

Facility recommendation of immunization for its healthcare workers alone has not been found to be associated with higher vaccination levels among its residents; in fact, in the 2004 NNHS, among residents in facilities that recommended vaccination for their healthcare workers, 63.9% of residents were vaccinated in those homes, compared with 64.1% of residents receiving the vaccine in homes that did not recommend the vaccine for their healthcare workers.[62]

Facility requires immunization of its healthcare workers

Few (8.4%) nursing home residents live in homes that require proof of vaccination of their healthcare workers as a condition for employment.[62] Residents in those homes that require proof of employees' vaccination had lower vaccination coverage than residents of homes that do not require such proof (62.8% vs 64.0%).[62]

Summary and critique of existing policies

Only SOPs and adoption of verbal consent for vaccinations have individually been shown to be significantly associated with higher influenza vaccination coverage among LTCF residents. One study found multiple strategies to be effective in increasing vaccination coverage.[71] SOPs are the most strongly recommended vaccination policy; our preliminary analyses suggest that financial worries may be a likely barrier to implementation of SOPs, so messages addressing cost savings gained from implementing SOPs may influence cost-concerned LTCFs.

CHAPTER 3 RACIAL INEQUITIES IN RECEIPT OF HEALTHCARE

Definition and scope of racial disparities in healthcare

Racial disparities in healthcare are defined as racial or ethnic differences in the quality of healthcare that are not due to access-related factors or clinical needs, preferences of the patient, and appropriateness of intervention.[72] Selected findings of the IOM's 2002 report, "Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care" include 1) Racial and ethnic disparities in healthcare exist and, because they are associated with worse outcomes in many cases, are unacceptable; and 2) Many sources – including health systems, healthcare providers, patients, and utilization managers- may contribute to racial and ethnic disparities in healthcare. A general recommendation was to increase awareness of racial and ethnic disparities in healthcare among the general public, healthcare providers, and key stakeholders. The research needs included 1) Conduct further research to identify sources of racial and ethnic disparities and assess promising intervention strategies; and 2) Conduct research on ethical issues and other barriers to eliminating disparities.[72] Finally they state, "Health equity is the fair distribution of health determinants, outcomes, and resources within and between segments of the population, regardless of social standing."

Racial inequities in access to nursing homes

Race has consistently been a predictor of nursing home admission, independent of other known factors.[73,74] Compared with Non-Hispanic Whites, older Blacks have lower levels of nursing home care despite higher levels of need and higher levels of Medicaid (which can pay for long term care). Although spending on

long-term care by both Medicaid and Medicare has grown, it has not been in such a way that is likely to alter the relationship between race and long-term care use.[75]

The use of formal long-term care services by Blacks, Hispanics, and Asians aged 65 years and older has historically been lower than that of non-Hispanic Whites. However the use of formal services has changed gradually over time for Blacks as anti-discrimination laws and public funding have provided greater access to nursing homes. According to the National Nursing Home Survey (NNHS), the proportion of Blacks in U.S. nursing homes has increased from 8.6% in 1995, to 9.3% in 1997, 9.9% in 1999,[12] and 10.9% in 2004 (CDC, unpublished). Although civil rights laws have been passed to allow greater access to care for minorities, the nursing facility still has the final say in who they let enter the home. In other words, a facility is under no mandate to admit any person because of race/ethnicity or funding– rather, it is at their discretion.

Studies have shown that differences in access to nursing homes are not explained by differential morbidity and disability rates or even by differential family values or living arrangements.[76,77] Instead, one study suggested economic barriers and discrimination in geographic access are what drive racial discrimination to access of long-term care facilities.[78]

One study found that facilities have "rules of thumb" about whether to accept a new resident into the facility. There may be racial disparities in admission due to the strategies, which included avoiding admission of costly or disruptive patients. For example, residents with diagnoses that were associated with severely costly medications would be avoided. Also, homeless people would be less likely to be

admitted because residents with no previous home are almost impossible to discharge. Methadone maintenance was also a reason to avoid admitting a new patient because someone using methadone is described as hard to serve, hard to discharge, and often physically aggressive, and may continue to use illegal drugs and therefore be hazardous to staff or to other residents. (J. Lynn, unpublished)

Racial inequities in access to 'upper-tier' facilities

Researchers have postulated that nursing home care is currently a two-tiered system. The lower tier consists of facilities housing mainly Medicaid residents and, as a result, has very limited resources. These homes have fewer nurses, lower occupancy rates, and more health-related deficiencies. They are more likely to be terminated from the Medicare/Medicaid program, are disproportionately located in the poorest counties, and are more likely to serve Black residents than are other facilities.[6]

Lack of expert assistance in long-term care choices

One problem encountered by minorities facing an 'explosion' of elderly in the future is the lack of expert assistance. The federal government does not have a program to help minority communities establish long-term care programs. For example, training in the management of long-term care choices other than nursing homes, (eg. assisted living facilities, adult day care or home healthcare) usually occur in on-the-job experience, which would be more accessible outside the minority community.

Evidence of extant segregation in nursing homes

It may be that the choice of a nursing home can be influenced by the ethnic/racial makeup of nursing homes; in other words, racial/ethnic minorities may choose to reside with other racial/ethnic minorities. Also, Blacks and other minority patients may choose to reside in facilities because of their location in the community, both of which may contribute to concentration of minorities in nursing facilities. However, other factors may also influence segregation. One study provides evidence that existing racial/ethnic disparities in nursing homes are in part attributable to hospital discharge practices that refer minorities to lower-quality nursing homes,[79] which tend to have higher proportions of minorities.

One study found that both geographic and nursing home segregation may influence differential access to nursing home care.[80] The findings of this study suggest nursing home segregation exists, but it is difficult to disentangle this segregation from the underlying geographic segregation. For example, nursing home residents in primarily White counties tend to mirror those demographics. However, counties in Mississippi with >20% African Americans had only one nursing home and that nursing home had <5% African Americans. In New York state in which African Americans represent 0.1 to 5% of the population in 54 out of 62 counties (87%), there are 117 (32%) nursing homes with no African Americans and 24 (7%) caring for >=10% African Americans, suggesting segregation. Also, the racial mix of the underlying community did not reflect the racial composition of the nursing facility.

Another study found that the mean family income and percentage of persons below the poverty line in the underlying community were not associated with the presence of African Americans in nursing homes.[81]

Refusal of healthcare among minorities

In 2002 the Institute of Medicine (IOM) reported that a few studies suggest that racial and ethnic minority patients are more likely than White patients to refuse treatment.[72] These studies found the differences in refusal rates to be small and that minority patient refusal does not fully explain healthcare disparities. A study published in 1990 examining respiratory illness among the elderly found that few residents refused the offer of influenza vaccine and that the different immunization rates in the homes reflected the policies of the individual medical practitioners.[82] A more recent study found that vaccination acceptance differed little between Black and White elderly paitents.[83]

Summary of potential issues in current LTC facilities

Poor-quality care has long been a problem in the nursing home industry.[84,85] Prior studies have found a direct relationship between racial mix of residents and quality of care in nursing facilities, suggesting racial bias rather than bias based on financial status is a predictor of quality in nursing facilities.[86] Because quality of care largely determines quality of life among those living in nursing homes, the racial difference is particularly egregious. In addition, although more minorities are using long-term care facilities, barriers to access still exist. Evidence supports the fact that segregation exists among LTCFs and that Blacks are more likely to live in facilities with poorer care than their White counterparts.

However, the facility characteristics found to be associated with segregation and poor care, for example, number of residents on Medicaid or 'low tier' homes, has not been consistent with the quality indicator, receipt of influenza vaccine. In fact, our studies found residents of homes certified for Medicaid-only have 20[46] and 32[62] percentage point higher vaccination coverage than residents of Medicare-only homes. Issues related to quality of care and segregation in LTCFs are mulitfactorial and deserving of further research.

CHAPTER 4 RACIAL INEQUITIES IN RECEIPT OF VACCINE

National W-B difference first reported: NNHS, 2004

Prior to the addition of immunization status to the MDS, the only instrument to examine immunization in nursing facilities was the National Nursing Home Survey (NNHS). The NNHS has been conducted periodically: in 1995, 1997, 1999, and 2004. Overall vaccination coverage did not change substantially over the four surveys (62.7% in 1995; 63.7% in 1997; 65.8% in 1999; and 62.9% in 2004).[11] Coverage for Whites remained steady (63.0% in 1995; 64.6% in 1997; 66.3% in 1999; and 64.0% in 2004), however, coverage for African-Americans did vary with coverage rates of 60.6% in 1995, 58.9% in 1997, 63.6% in 1999, and 55.0% in 2004. The 8.6 percentage point drop in coverage for African-Americans between 1999 and 2004 resulted in a 9 percentage point disparity between Whites and Blacks in 2004 (p <.0001).

In a study we conducted during 2000-2001 in 14 states with an average sample of 20 nursing facilities per state we also found an 8 percentage point difference in vaccination coverage between Whites (59%) and Blacks (51%).[12]

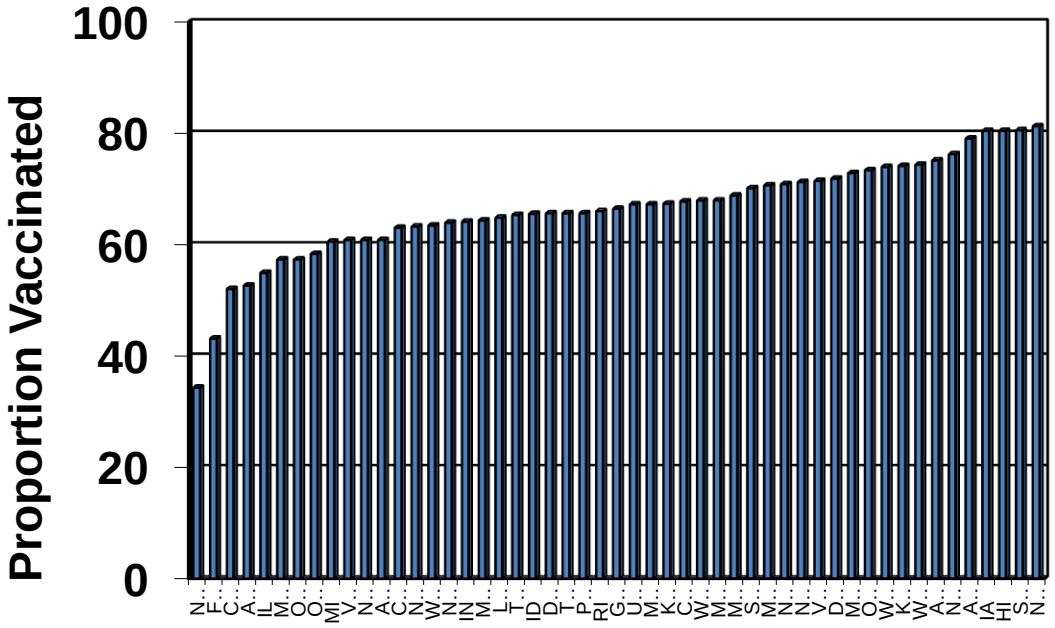
National W-B difference confirmed: MDS, 2005-2006

To examine racial disparities within and between facilities as well as states, adequate sample size of minorities is requisite. However, the NNHS surveys only 6 residents per home in 8000 to 13000 facilities. This design assumes high correlation within clusters so few subjects are needed within clusters, but a large number of clusters are needed to have adequate power to detect a difference. Cluster sampling generally yields estimates with larger variances (i.e., lower precision) than samples

of the same size if they were randomly selected individuals. In terms of racial disparities it is not apparent that correlation within clusters, by race, would be high and a sample of 6 per home is not enough to confirm that assumption. Hence, census data or the MDS is more appropriate to examine existence of racial disparities, and in particular, whether racial disparities vary within and/or between facilities.

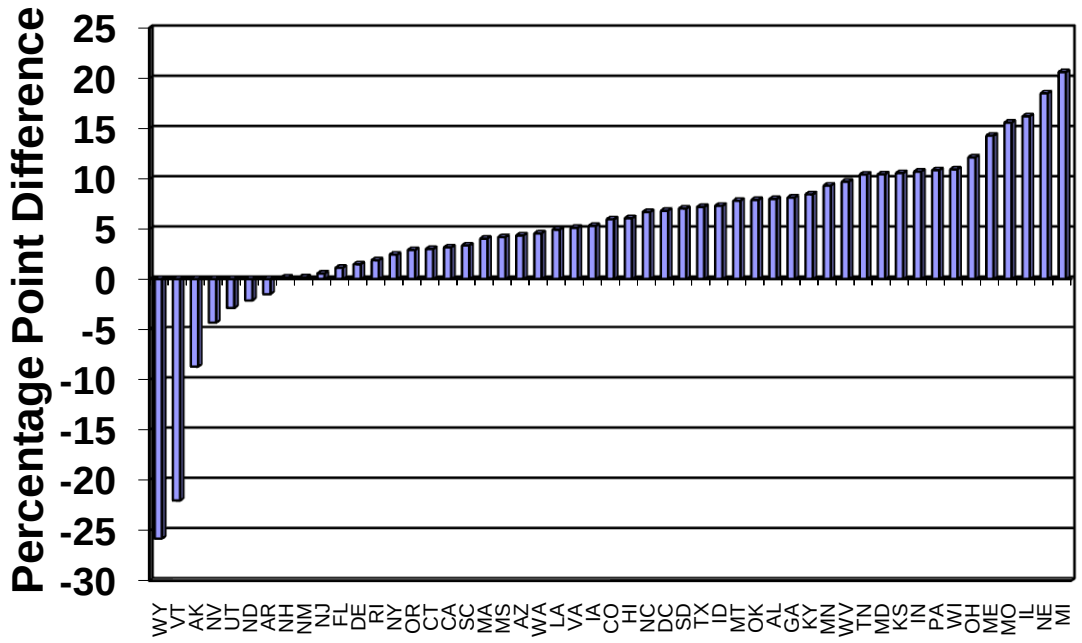
National vaccination coverage for the 2005-2006 season was 72% among LTCF residents who lived in the facility from October 1 through December 31, 2005 but could have been discharged between January 1 and March 31, 2006.[46] Among residents who ever lived in the facility between October 1, 2005 and March 31, 2006, vaccination coverage was 62.3%.[52] The median state coverage during this time period was 66.4% (range: 34.3% - 81.2%) [Figure 4-1]

Figure 4-1. Proportion Vaccinated by State, MDS 2005-2006



State median coverage among Whites was 67.8% and among Blacks was 60.6%.; the state median difference in coverage between Whites and Blacks was 7.3 percentage points [Figure 4-2]

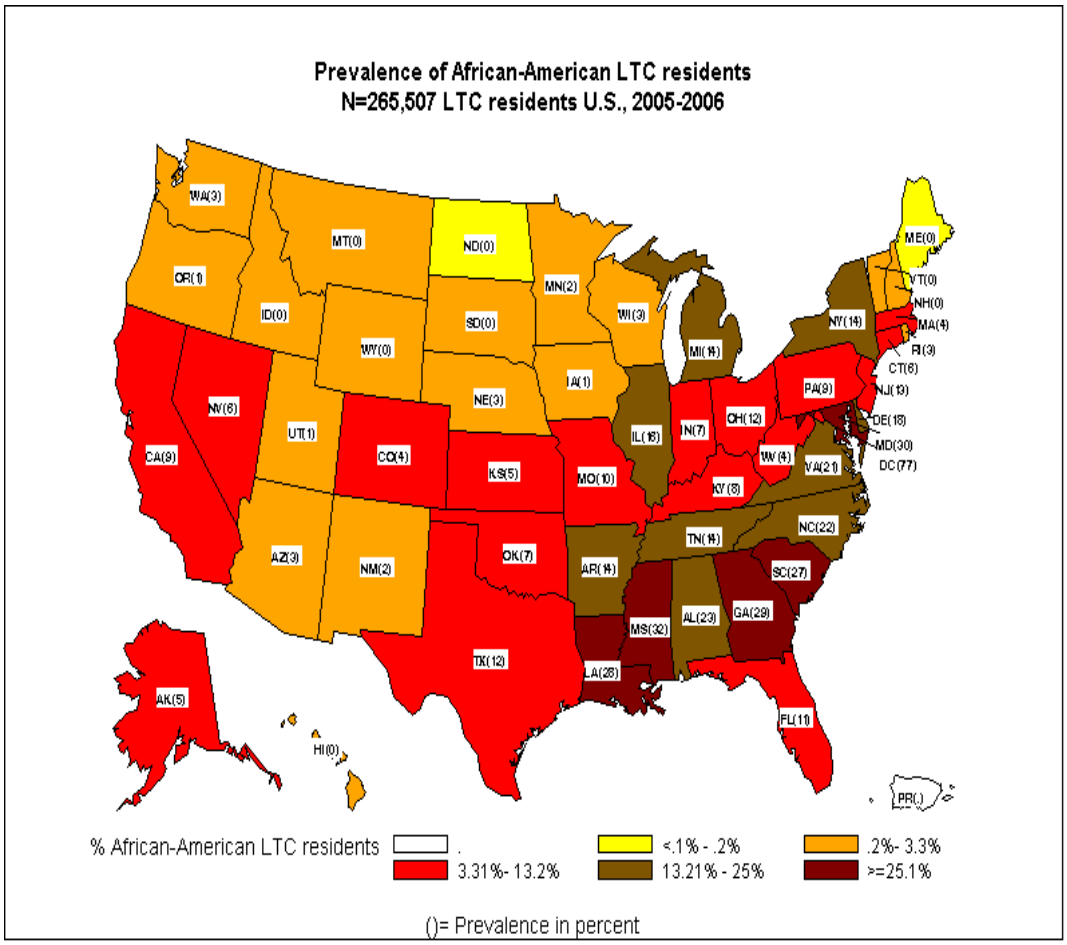
Figure 4-2. Total difference in White-Black immunization coverage per state, 2005-2006



W-B vaccination difference varied by state and LTCF

Although most Black residents live in the southeastern states [Figure 4-3], the difference in *offering* the vaccine between Whites and Black residents is most notable in the Midwestern, Central and Mid-Atlantic states. [Figure 4-4] When the LTCF was controlled for (i.e., the average LTCF for each state), the racial difference in offering levels of the vaccine lessened. [Figure 4-5] Similarly, the overall racial difference in state level *proportion of vaccinated* residents is highest in the

Figure 4-3. Proportion of black nursing home residents by state



Midwestern, Central and a few southeastern states. [Figure 4-6] However, when LTCF was controlled for, the racial difference in vaccine uptake dropped in some states in the southeast, increased in states with very few Blacks in the Western region, and remained high in two Midwestern states with a large number of Blacks (Michigan and Illinois) [Figure 4-7]. This suggests wide variability in vaccination offering and uptake between LTCFs within states as well as between states.

Figure 4-4. State racial gap in offering vaccine

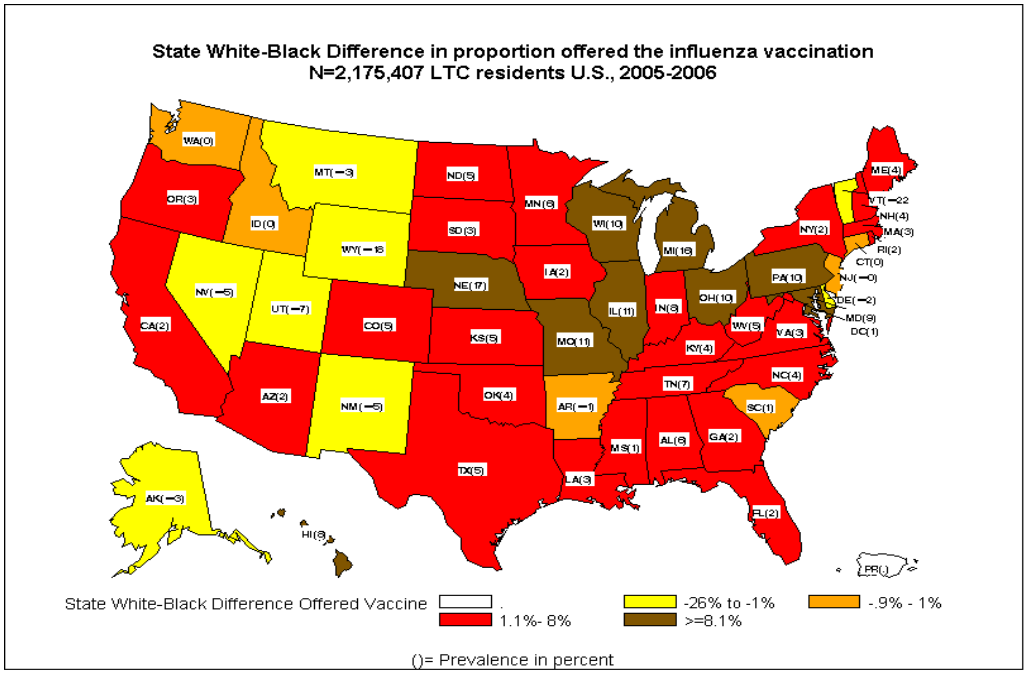


Figure 4-5. Facility racial gap in offering vaccine

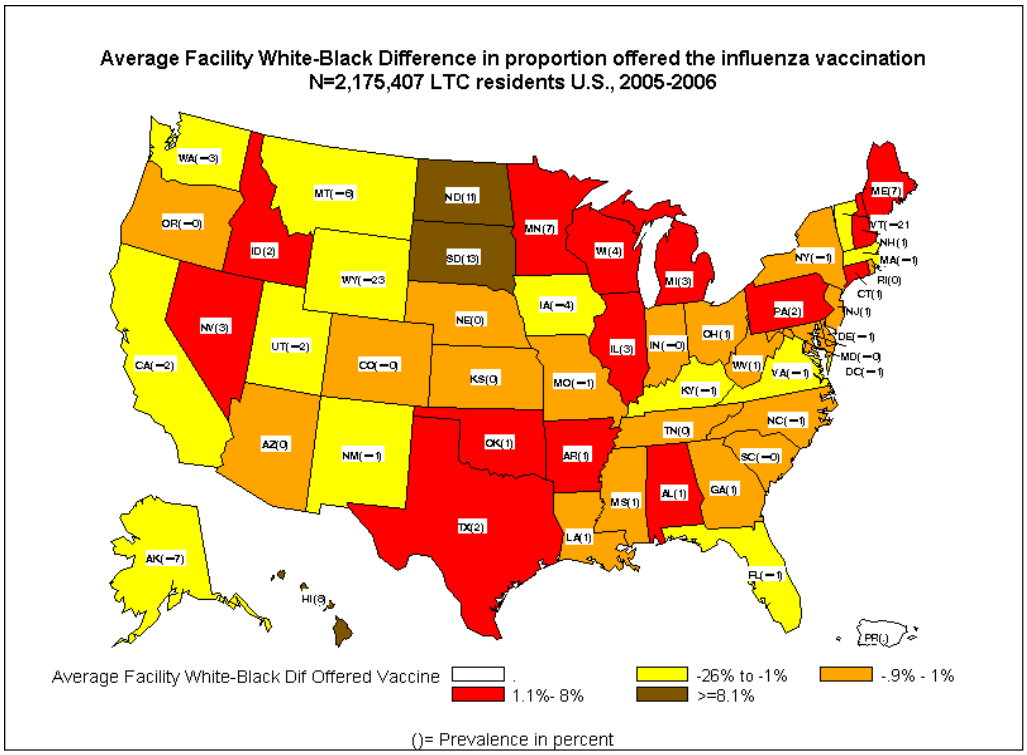


Figure 4-6. State racial gap in influenza vaccination, 2005-2006

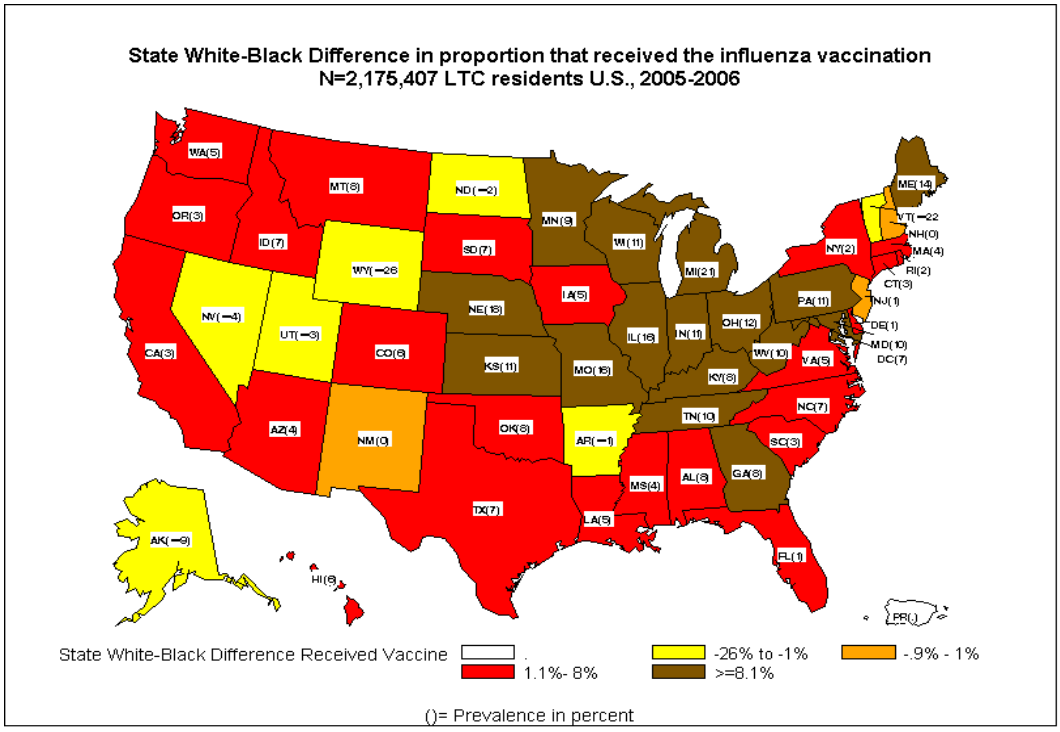
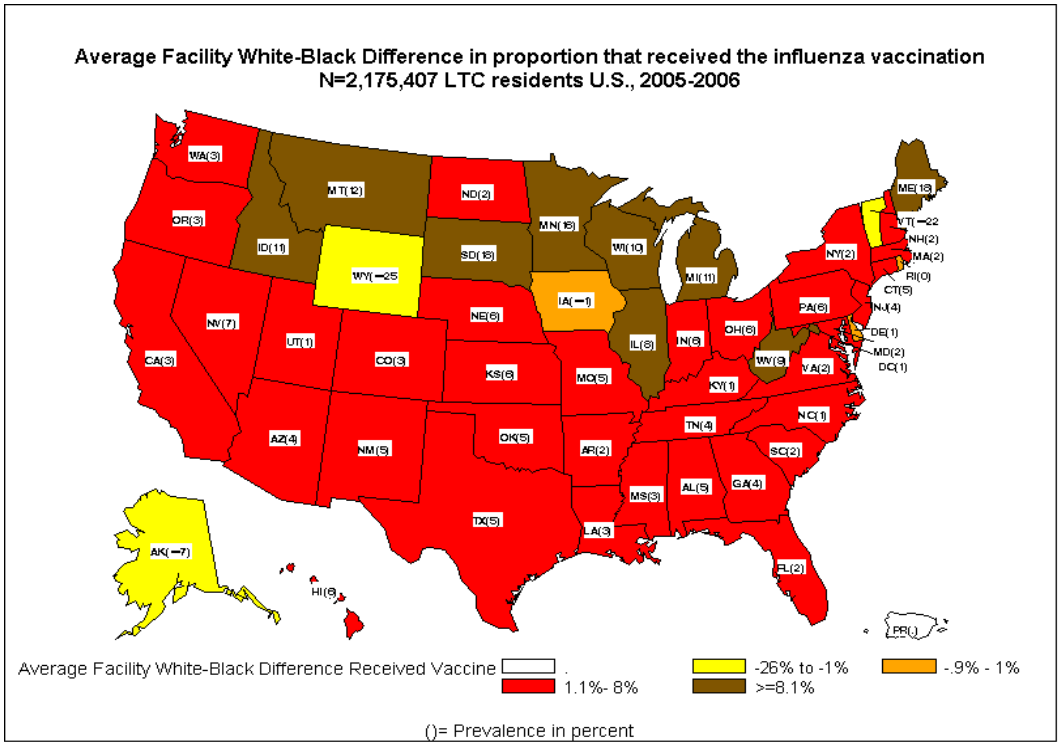


Figure 4-7. Facility racial gap in influenza vaccination, 2005-2006



Standing order protocols (SOPs) associated with vaccination

Does the national W-B gap narrow in homes with SOPs?

SOPs have been shown to be associated with higher influenza vaccination coverage.[87] Although previous studies did not specifically examine racial differences in vaccination status with use of vaccination strategies, in our previous study using the NNHS we found race to be a strong, statistically significant confounder between use of standing orders for influenza vaccination and receipt of the vaccine.[7] We then used the NNHS to determine whether specific facility-wide vaccination strategies were associated with a narrower national racial gap in influenza vaccination among nursing home residents. Compared with other vaccination strategies, standing orders for influenza vaccination was associated with the highest adjusted vaccination coverage for both Black (64.3%) and White residents (68.0%), and the difference between Blacks and Whites was small (3.7 percentage points) and not statistically significant (p=0.145).[88]

Looking within a state for answers

Nationally, we found large variation in vaccination coverage and racial differences in vaccination between states and nursing homes. Some states had <1% Black residents, some had large racial differences in vaccination and some had little difference. To determine if the racial differences in vaccine uptake were really within or between nursing homes, we elected to focus on one state with a large statewide unadjusted racial difference in influenza vaccine uptake.[89] Michigan had the largest statewide unadjusted racial inequity (21.1 percentage points) for the influenza vaccination quality indicator among long-term care residents in the 2005-

06 season.[7] In addition, fewer than 2% of the nursing home residents in Michigan were other than non-Hispanic White or Black, and the proportion of Black nursing home residents was higher there than in most states. Further, the vaccination gap by race among nursing home residents was substantially higher than that reported among the non-institutionalized population (by approximately 10 percentage points).[8]

Racial distribution among facilities

Of the 80,327 residents in the Michigan population, 11,269 (14.0%) were Black and 69,058 (86.0%) were White. Among the 403 non-hospital based nursing facilities with complete data, no residents were Black in 111 (27.5%) facilities, all residents were Black in 1 (0.3%), and the remaining 291 (72.2%) facilities were racially mixed. To assess racial differences in vaccination within and between nursing homes, we grouped facilities by percent of Black residents: 0%, 0.1% to 4.9%, 5% to 19.9%, 20% to 49.9%, and $\geq$ 50%. These categories were chosen to examine homes with no Black residents (e.g., 0%), homes in which Blacks were in the majority (e.g., $\geq$ 50%) and groups in between with sufficient sample sizes. This categorization can be used in other states. Approximately 47% of all the Black residents in Michigan lived in 41 homes in which they were the majority ($\geq$ 50%).

Vaccination Coverage

Overall unadjusted coverage in Michigan for all residents who lived in a nursing facility during the 2005-2006 influenza season was 60.5%, 63.5% for Whites and 42.9% for Blacks, for a disparity of 20.6 percentage points.

Michigan: inequities in receipt of vaccine within nursing homes

To examine vaccination *within* and *between* facilities, we calculated probabilities based on estimates from the polytomous multilevel model for vaccination, refusal, and not offering the vaccine for both Whites and Blacks in each nursing home.[89]

Whites had slightly higher adjusted vaccination coverage than Blacks in all groups of facilities. [Figure 4-8] Table 4-1 shows median vaccination coverage and refusal vaccination levels by race by percent Blacks in homes. After adjusting for the clustered structure of residents within nursing facilities and known resident- and facility-level confounders**,** the median range of difference in coverage *within* homes by proportion Blacks in the nursing home was 5.1 to 5.7 percentage points. The median difference in refusing the vaccine was $\leq$2.5 percentage points for each group of facilities.

Table 4-1. Multilevel Model results: Within and between facility vaccination coverage by % Black residents in the facility, Michigan, 2005-2006

Facilities grouped by percent Black residents in the homes	# LTCFs	median # residents (range)	Distribution (%) in Michigan		Vaccination Coverage*								
					Vaccinated&			Refused			Not offered**		
			Blacks	Whites	White	Black	difference	White	Black	difference	White	Black	difference
1) 0% Black residents	111	159 (22 – 383)	0	23.1	81.4	-	-	7.7	-	-	9.8		-
2) 0- <5% Black residents	118	217 (40 - 1,242)	4.4	35.0	74.6	69.6	5.1	9.9	12.5	-2.5	14.6	16.9	-2.2
3) 5% to <20% Black residents	100	238 (61 – 1,240)	26.2	32.3	66.0	60.2	5.4	9.8	12.2	-2.3	22.3	25.2	-2.9
4) 20 to <50% Black residents	33	222 (66 - 668)	21.9	7.6	57.7	51.8	5.7	10.4	12.9	-2.1	22.4	26.0	-3.0
5) >50% Black residents	41	169 (45 – 526)	47.5	2.0	51.0	45.3	5.6	11.7	14.3	-2.4	32.0	36.0	-3.0

Difference in each category is the White-Black median difference for the facilities in that stratum.
Coverage probabilities (e.g., vaccinated, refused, and not offered) are **medians** for the facilities in each stratum and therefore do not add to 100%
& Adjusted vaccinated and refused probabilities are from a multilevel model with a multinomial outcome: vaccinated, refused, unvaccinated –other reasons
*Adjusted: Multilevel model, adjusted for covariates: sex, level of education, Medicaid, Medicare, private insurance, age, number of residents in the facility, proportion African-Americans in the facility, facility's affiliation with multi-facility chain,

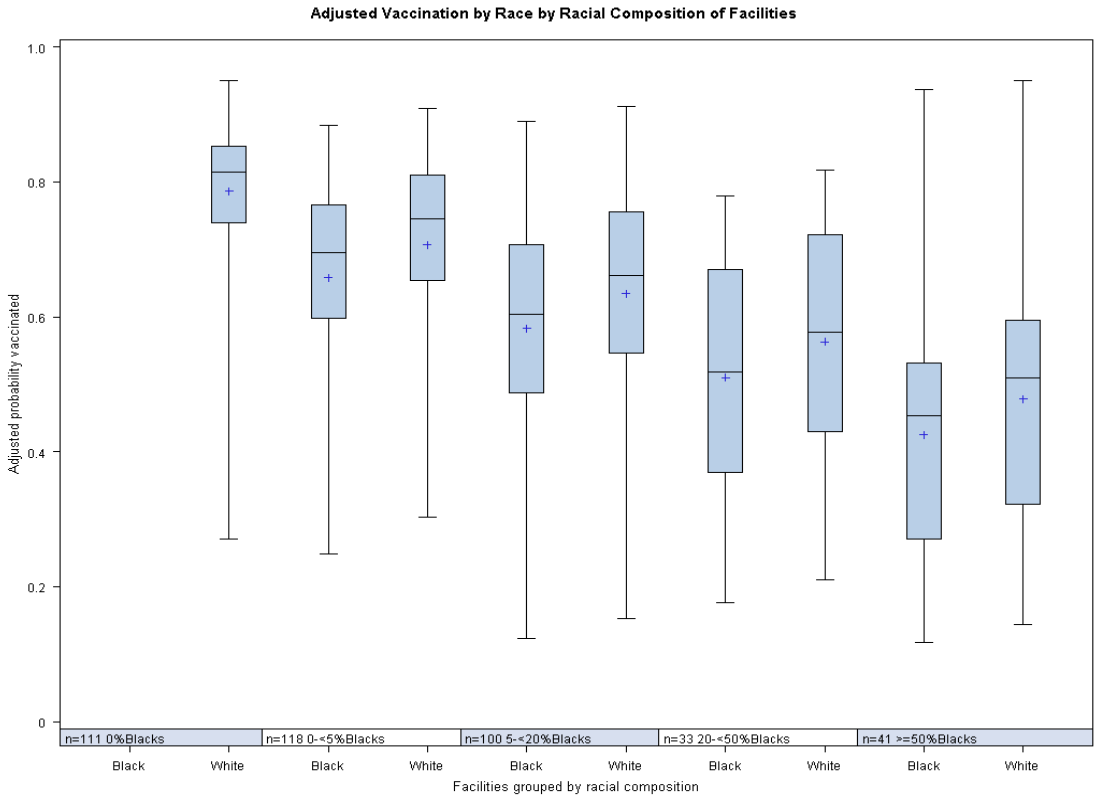
type of ownership, type of certification, compliance with program requirements for Medicare and/or Medicaid certification, number of nurse full-time equivalents, metropolitan statistical area, and proportions of residents on Medicaid, Medicare, and Private pay

**Adjusted not offered probabilities also include residents who were contraindicated for the vaccine (1-2%). There were no racial differences in proportions contraindicated.

Michigan: inequities in receipt of vaccine between nursing homes

To assess variability of vaccination *between* all nursing homes, we tested the significance of the random intercepts (i.e., null hypothesis of variances equal to zero) in the multilevel model that included all 403 facilities.

Figure 4-8. Michigan MDS, adjusted vaccination by LTCF and racial composition of the LTCF, 2005 - 2006



+ denotes mean
The horizontal line in the middle of the box plot is the median
The length of the box represents the interquartile range (distance between the 25th and 75th percentiles).
The vertical lines (called whiskers) issuing from the box extend to the group minimum and maximum values.
Vaccination coverage is adjusted for: sex, education, Medicaid, age, number of residents in the facility, proportion African-Americans in the facility, facility's affiliation with multi-facility chain, type of ownership, type of certification,

compliance with program requirements for Medicare and/or Medicaid certification, number of nurse full-time equivalents, MSA, and proportion of residents on Medicaid.

Vaccination coverage varied *between* the 5 groups of facilities; notably, 47.5% of Blacks lived in facilities where the median coverage was <50% and 58.1% of Whites lived in facilities where the median coverage was >75%. In the group of facilities with ≥50% Blacks, the adjusted probability of vaccination for both Whites (median: 49.2%) and Blacks (median: 43.0%) was lowest among all strata of homes. In the 2 groups of facilities in which Blacks were 0.1% - <5%, and 5% - <20% of the facility population, Blacks and Whites had higher vaccination coverage than in the facilities with over 20% Blacks. Vaccination coverage in the 0% Black homes was higher (median: 82.1%) than in the other facilities.

Random effects were included in the model to account for and test the variance (H_0: $\sigma^2_{01} = \sigma^2_{02} = 0$) in vaccination between homes. [see Appendix 1] Controlling for correlation as well as resident and facility level confounders, differences between racial groups in receiving the influenza vaccine and for refusing vaccine, were highly statistically significant ((H_0: $\beta_{81} = \beta_{82} = 0$, *p*-values <0.001). Additionally, the variance components were highly significant (p-values <0.001), suggesting remaining unexplained variance in vaccination coverage between nursing homes after modeling the effect of race, and controlling for resident and facility level confounders. The median proportion not offered the vaccine was the highest and the receipt of vaccine was lowest in facilities with the largest proportion

of Black residents. It is clear that differences *between* facilities drive the magnitude of the state-wide inequity.

Next steps:

Does frailty contribute to the W-B vaccination gap within facilities?

In Michigan, racial differences *within* nursing homes were reported in receipt of the influenza vaccine, refusals, and in being offered the vaccine. The first dissertation aim is to determine if frailty could be contributing to the racial gap in vaccination status within facilities in Michigan. One study found Black nursing home residents enter the facility in worse condition than their White counterparts.[90] Another study found that frailty was negatively associated with receipt of influenza vaccine among healthy community-dwelling seniors.[16] Thus we seek to determine if residents' health condition modifies the effect of the measure of race in refusing, being offered or receiving vaccination among nursing home residents in Michigan.

Barriers to implementing SOPs in LTCFs

In our previous study we found that facility staff reported legal concerns such as liability for the facility and that the staff lacked legal authority were significant barriers to implementing SOPs.[61] That analysis included logistic regression examining various factors with use of SOPs. The perceived barriers to implementing SOPs were not examined in relationship to one another. Included in the second dissertation aim, using factor analysis we seek to understand how the perceived barriers are related to one another and to determine if underlying constructs that drive these barriers can be identified. Further, we seek to determine

if these barriers are associated with the racial composition of the facility and how that influences use of SOPs and vaccination coverage at the facility level.

Influential authorities making vaccination decisions in LTCFs

Little evidence has been reported to establish which authorities most influence influenza vaccination policies in nursing homes. Using factor analysis we seek to understand how authoritative bodies such as the ACIP, the Quality Improvement Organizations (QIOs), and the state certification surveyor and internal facility staff such as the director of nursing and infection control coordinator are related to one another and to determine if underlying constructs that drive these influential authorities can be identified. Further, we seek to determine if these authorities are associated with the racial composition of the facility and how that influences use of SOPs and vaccination coverage at the facility level.

Relationship among barriers to SOPs, influential authorities, and racial composition of the LTCF with use of SOPs and vaccination coverage

As discussed previously, the second dissertation aim seeks to determine If the observed variables interrelate to measure constructs for the types of authorities most influential in vaccination policies and barriers to implementing SOPs. This aim further seeks to determine 1) whether observed variables interrelate to measure the following constructs: types of authorities most influential in vaccination policies, barriers to implementing SOPs, and two-tiered (e.g., 'haves' and 'have nots') systems of resources jointly 2) if these constructs are concomitantly associated with each other, the racial composition of the facility, and with implementing SOPs, and 3) if

these constructs are directly or indirectly, via implementation of SOPs, associated with vaccination coverage.

Examining factors associated with the W-B gap between facilities

In our previous analysis, we found the Michigan state-wide vaccination inequity among nursing home residents results from Blacks disproportionately living in nursing homes where vaccination coverage is lowest. The inequity between facilities could be attributed to facility-level difference in offering. The third dissertation aim is to determine if racial composition and constellations of various factors associated with it jointly contribute to racial differences in vaccination offering levels between LTCFs.

CHAPTER 5 METHODS

W-B vaccination difference within and between LTCFs in Michigan

Study design

Cross-sectional

This study includes all nursing home residents in CMS-certified nursing facilities who had assessments conducted with target dates between October 1, 2005 and March 31, 2006 in Michigan; hence it is a cross-sectional study.

Study population

During the 2005-2006 influenza season, there were 426 Medicare- and Medicaid-certified nursing facilities in Michigan, 18 of which were owned or operated by hospitals. These hospital-administered facilities are post-acute recuperative settings serving mainly Medicare-eligible residents. Since the focus of our study is on the traditional nursing home population, hospital-based facilities and residents were excluded from the analyses. The analyses in this dissertation included residents from nursing homes that had complete facility-level data (403 of 408 (98.8%)).

Study eligibility

Resident assessments are administered at admission, quarterly, and for any significant change in condition for all residents in Medicare/Medicaid certified facilities. From October 1, 2005 through March 31, 2006, 241,485 resident assessment instruments (RAI) were conducted in Michigan, submitted to CMS, and included in MDS. To identify a unique assessment for residents with multiple assessments, we used probabilistic software, LinkPlus,[9] thereby reducing the

number of assessments to 92,425; of these, 90,120 were non-Hispanic White or Black residents that had complete information and represented 83,534 residents. This includes all residents who ever lived in a nursing facility (or in more than one facility, n=6,586), in Michigan during the study period.

The number of residents is much higher than that estimated to be in Michigan at a point in time because the population is dynamic.

Data Collection (sources)

Facility data

Description of On-line Survey and Certification Assessment Reporting System (OSCAR)

OSCAR is a federal administrative database containing structural, staffing and other information on LTCFs. OSCAR provides staffing data for all U.S. nursing homes that Medicare and/or Medicaid certifies. State survey and certification agencies collect the data, which are part of the annual nursing home certification and recertification process. Each facility completes a standardized form about the facility characteristics, e.g., number of beds, affiliation, etc., resident characteristics, e.g., limitations, chair bound, etc., and staffing levels. State surveyors review the form and enter the data into the OSCAR database. State surveyors also visit each facility and decide whether the facility meets each standard.

Strengths and Limitations of OSCAR

OSCAR provides comprehensive information on certified U.S. nursing facilities. Although very limited staffing data are available, one can analyze the data to see the association between staff levels and facility characteristics, resident

characteristics, and other quality indicators. Uses of these data are widely accepted in the long-term care research field.

Validation analyses have shown considerable differences between staffing levels from OSCAR and payroll data for the same time period, suggesting that OSCAR staffing data for some facilities are unreliable.[91] The data were even less consistent for nurse aides than for RNs and LPNs. Also, old OSCAR data are overwritten when a new survey is conducted, which makes it very difficult to conduct historical analyses.

Facility characteristics examined

Administrative characteristics

For profit or proprietary homes are thought to be profit-driven and therefore expend fewer resources on resident care than non-profit homes, resulting in poorer quality.[92] One study that examined almost all 14,000 nursing homes in the U.S. in 1998 found that for profit homes had higher rates of all types of deficiencies than did nonprofit or government-owned facilities, and that they were more likely to be located in the South or West than in the Northeast and Midwest.[93] In fact, public policy has been proposed to eliminate U.S. for profit nursing homes due to their purported poorer quality.[94]

Facilities that are part of a chain have been reported to have lower costs which may affect care.[95] Economic theory suggests that whether or not chain ownership would affect nursing home costs depends on if there are economies of scale at the chain-level, as opposed to the facility-level. In other words, multi-facility

(chain) ownership would confer a cost advantage only if there are chain-level cost savings or if average cost were lower for chain homes than for non-chain homes at any given level of output. An example would be if there were some benefit in obtaining and administering the influenza vaccine at the chain level. Other examples of multiple-home economies of scale are capital savings, due to lower interest expenditures on building and equipment or lower average costs of centralized management. Also, chain might lower labor costs by sharing various types of consultants (e.g., for nursing, physical therapy, or social work). This effect of chain ownership on average cost is an empirical question, because there is no theoretical basis for assuming that chain ownership will indeed lead to chain-level economies of scale. In fact, if firm-level economies of scale do not exist, either chain size (ie, the number of nursing homes in a chain) does not affect average cost or average cost increases as chain size increases. In this case there would be chain-level diseconomies of scale, which are usually attributable to coordination problems and/or limits to management. It is possible that this may be true in the case of influenza vaccination for residents. In a study conducted in 14 states during 1999-2000, residents in multi-facility owned chains had lower vaccination coverage than residents of independent owned homes (53.4% vs 64.7%) (CDC, unpublished). Also in a national survey conducted in 2004 vaccination coverage among residents of multi-facility chain-owned nursing homes was significantly lower (61.2%) than among residents of independent-owned homes (66.7%). Vaccine cost to providers is not publicly available so it is unknown if there truly is an economy of scale for chains regarding this particular product. Also, drugs are commonly bundled in

contracts with providers, so determining the 'true' economy of scale would require an entirely separate analysis.

Case-Mix (severity of illness of residents)

There are several variables (i.e., measures), some with differing objectives, to describe the severity of illness of a facility's residents. In the 1980's, Resource Utilization Groups (RUGs) were established for reimbursement purposes (e.g., to simplify the process, although this has been debated). Today, 44 RUGs exist that residents are assigned to. As data from the resident assessment instrument (RAI) are key entered at the facility, they are sent to be housed in the MDS but also are used to determine what RUG the resident will be assigned to for facility reimbursement. Other ways of defining case mix can simply be to include the proportion residents with specific outcomes or needs, such as diabetes, falls in the past 180 days, poor quality of life, speech problems, use of psychotropic drugs, psychiatric problems, cognitive performance scale (categorized low, medium, and high), incontinent bowel, incontinent bladder, dependence on drugs, and average number of prescriptions.

Deficiencies

State survey and certification agencies visit each facility and decide whether the facility is deficient in meeting standards in the following areas: administration, quality of care, resident rights, mistreatment, environmental, pharmacy services, residents' assessments, and nutrition/dietary. Surveyors report deficiencies as being isolated, a pattern, or widespread and are reported by severity and level of

harm to the OSCAR. Prior research has found that Blacks are disproportionately admitted to nursing homes with significantly greater government-assigned deficiency citations than Whites.[96]

Staffing resources

OSCAR staffing variables cover a small number of occupations, including registered nurses (RNs), licensed practical nurses (LPNs), and nurse aides. Each occupation breaks down into full-time (35 or more hours per week), part-time (less than 35 hours per week), and contractors. Staffing variables are reported in full time equivalency (FTE) based on a 35-hour workweek from the two weeks prior to their annual survey. To convert to patient hours per day, the total number of FTEs for each occupation is divided by the number of residents in the facility (reported in OSCAR). Staffing resources are also assessed as a ratio of total FTEs in the facility to the total number of residents during the influenza season and to the number of beds in the facility.

Funding characteristics

One study published in 2005 found that the funding mix of nursing home residents (i.e., proportions of residents on Medicare, Medicaid, and with private payment resources) has created a two-tiered system (e.g., 'haves' and 'have nots').[6] Also, Black nursing home residents are disproportionately located in facilities housing mainly Medicaid residents, with a net consequence of having access to far fewer resources.[6]

Resident data

Description of Minimum Data Set (MDS)

In 1987 Congress enacted major nursing home reform legislation to insure residents receive initial and ongoing assessments to identify and treat existing and new medical conditions.[84] The Minimum Data Set (MDS), the resident assessment instrument developed in part for this purpose, is administered at admission, quarterly, and for any significant change in condition for all residents in Medicare/Medicaid certified facilities (97% of all US nursing home residents). Data from the MDS is used to create 24 quality indicators that indicate either the presence or absence of potentially poor care practices that affect outcomes among residents.[97] MDS is also meant to be a vehicle for nursing homes to do care planning.[84] Although the primary aim for the development of the MDS is to improve the quality of care in nursing homes, it also provides a unique database for researchers.

Through an intra-agency agreement of the Centers for Disease Control & Prevention (CDC) and the Centers for Medicare and Medicaid Services (CMS) (from previous collaborations), MDS was obtained, including all assessments during the 2005-2006 influenza season. Approval from CDC's IRB was obtained. Identifiers were used to de-duplicate and reassign study identifiers to account for residents given multiple identifiers within states and also for residents who moved between states and were given multiple identifiers as such. Ten datasets including 19 million observations were obtained from CMS for assessments completed October 1, 2005 through December 31, 2006 (although immunization information is only collected from October 1 through June 30 annually, assessments can be entered

retroactively). First, residents were given a new identifier by concatenating state id's with state-given resident id's. Using object (hash) programming, observations of the same person were determined using key variables. For observations in which it was unclear if it was a unique person were then exported to a dataset. Link Plus, a probabilistic record linkage program designed by CDC's Division of Cancer Prevention and Control in support of CDC's National Program of Cancer Registries (NPCR), was used to de-duplicate records. A unique study identifier was then assigned to all residents and all identifiers were deleted, per CDC IRB requirement for exemption. Description of data management or merging the various datasets can be found in Figure 5-1.

Reliability/Validity of the MDS Data

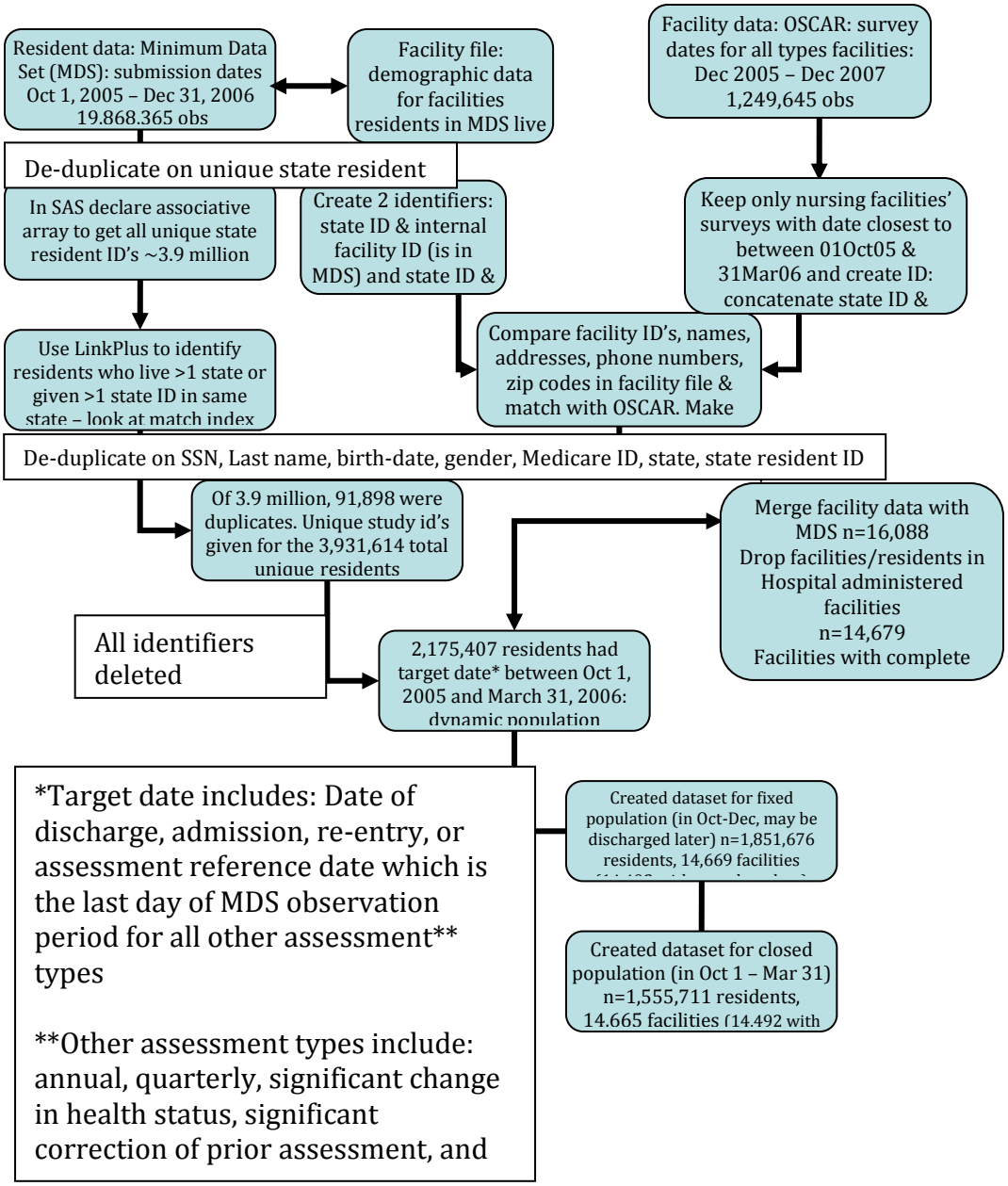
MDS data rely on reporting from facility staff, so underreporting of problem areas is possible. Validation studies of MDS found that new and revised items have both reliability and clinical utility.[98] Some items of MDS have been assessed for reliability but the new immunization measures have not been assessed for reliability or for validity. Validation studies to carry out such assessments are currently ongoing.

Outcome Measure: Immunization status in MDS

Version 1.30 of the MDS Data Specifications went into effect on October 1, 2005. This new version adds a new Section W (Supplemental MDS Items) with 5 items. Section W is only in effect on assessments with assessment reference date (MDS Item A3a) on or after October 1, 2005, on discharge tracking forms with discharge date (MDS Item R4) on or after October 1, 2005. The date range for

requiring completion of the influenza vaccine items (W2a and W2b) is from October 1 through June 30. However, the question on the form asks specifically to answer for vaccination status from October 1 to March 31 of the previous influenza season.

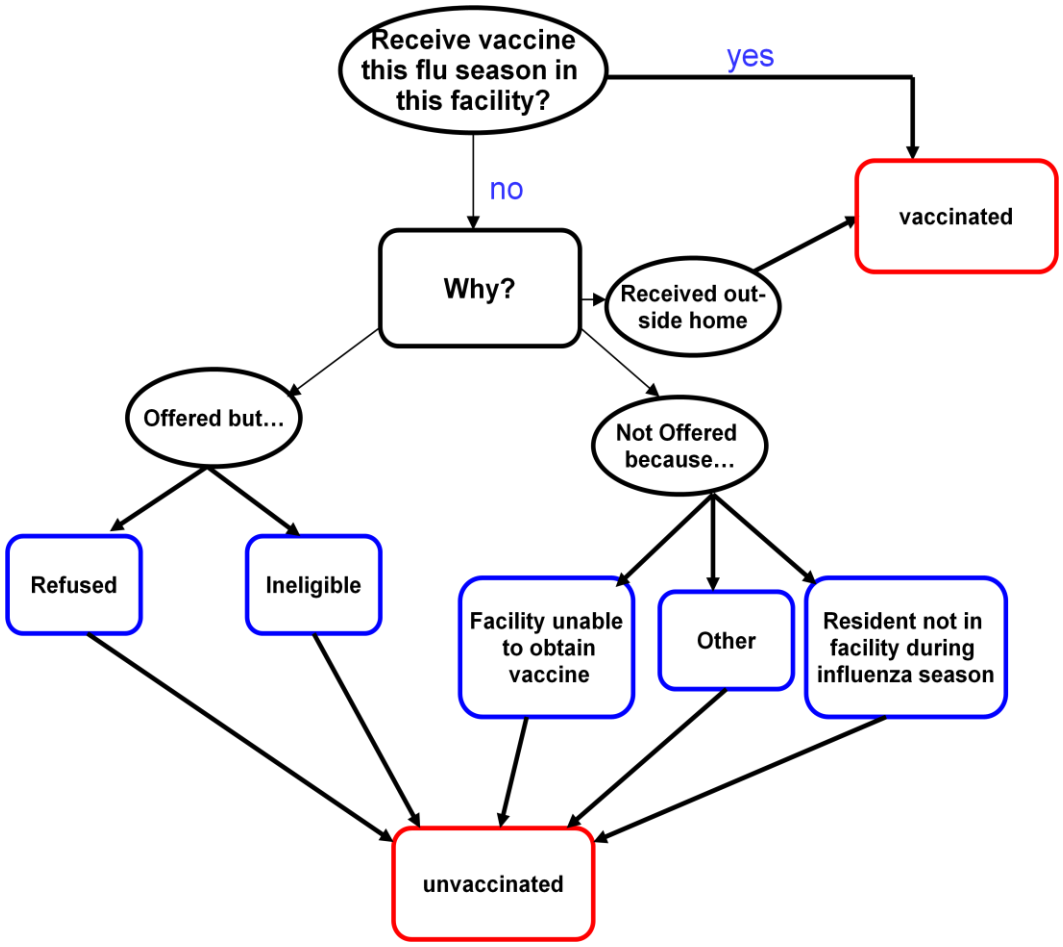
Figure 5-1. Flowchart describing merging of resident and facility data



The immunization supplement to the assessment instrument asks, "Did the resident receive the influenza vaccine in this facility for this year's influenza season

(October 1 through March 31)?" The next question asks, "If influenza vaccine was not received, state reason: 1) not in facility during this year's flu season; 2) received outside of this facility; 3) not eligible; 4) offered and declined; 5) not offered [other]; and 6) inability to obtain vaccine." [Figure 5-2]

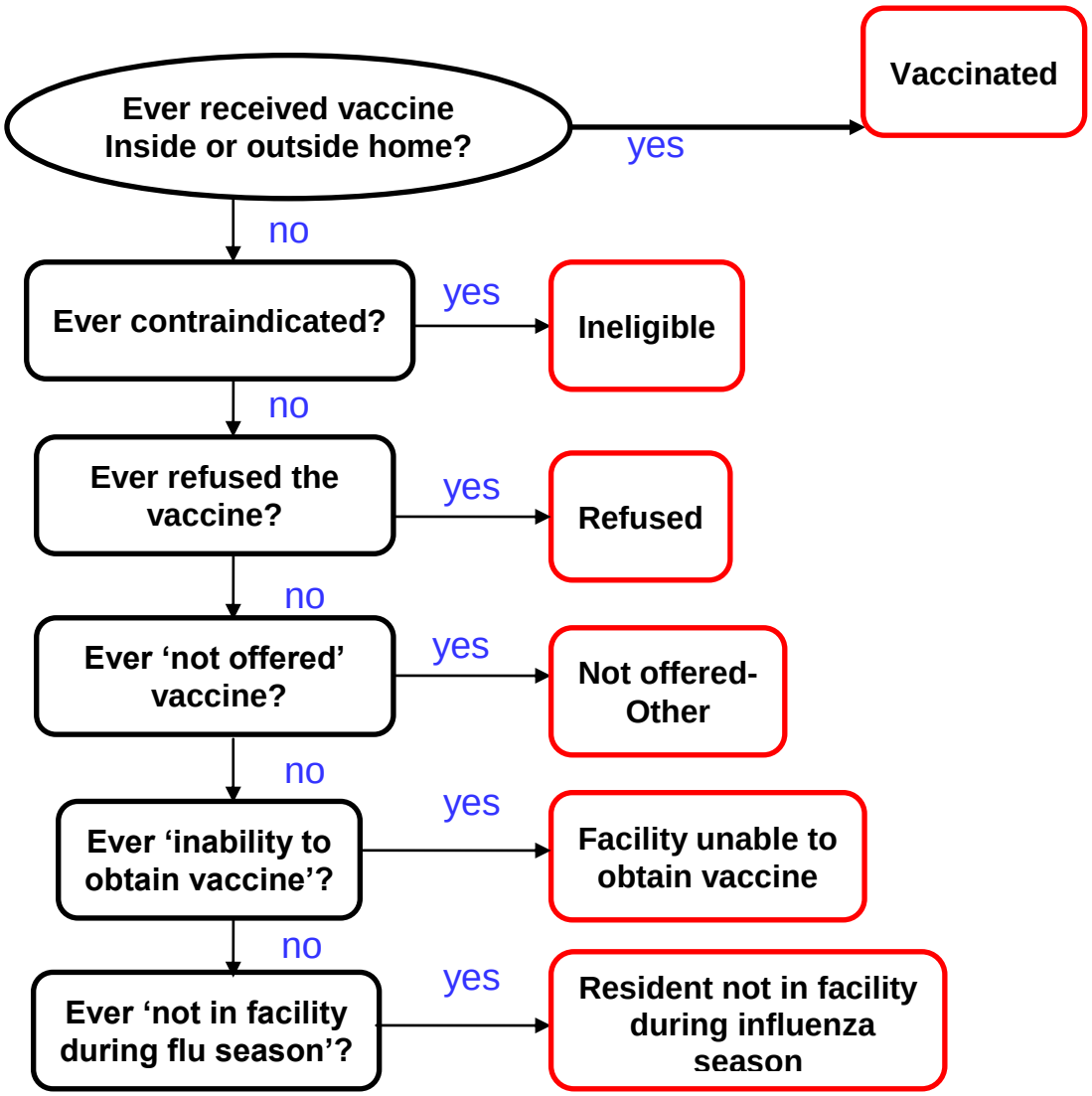
Figure 5-2 Facility determination of resident vaccination status



An unable to determine (dash) response has been allowed on all vaccine items (W2a, W2b, W3a, W3b) and inter-item consistency requirements have been defined when a dash value is present. Because of the mandate to offer influenza vaccine, CMS allowed this response so that nursing homes would not have to 'incriminate themselves' if they failed to offer the vaccine (personal communication,

Craig Hales, Medical Officer, CMS). Because it was the intent of CMS that the 'unable to determine' response was really 'not offered the vaccine,' this response will be examined several ways for the analyses and further steps will be taken to substantiate the meaning of this response with nursing home administrators. Also, it is important to note that the software used by nursing facilities to enter assessments varies between facilities and also within and between states. For example, some may have a block to the vaccination field if the date of the assessment does not fall between October 1 and June 30, whereas others may not. According to the Rhode Island QIO, typically one staff member per facility does all key entry for assessments (personal communication, Nelia Odom). This is not surprising given that a recent report by the IOM stated more cross-training in long-term care facilities would help make use of the limited staff resources and likely make care more efficient.[25] Because several assessments were conducted for most residents during the influenza season and various responses for immunization status could be given, an algorithm was used. [Figure 5-3]

Figure 5-3. Determination of vaccination status



Exposure Measure: Race/Ethnicity in MDS

All resident-level variables come from the RAI and include level of education, sex, age, and race. Instructions for completing residents' assessments include reporting race 'within which the resident places self.'[10] The RAI has one variable for race/ethnicity with responses: 1) American Indian/Alaskan native, 2) Asian/Pacific Islander, 3) Black, not of Hispanic origin, 4) Hispanic, and 5) White, not of Hispanic origin. Residents reported as other than 'White' or 'Black' comprised <2% of the nursing home residents in Michigan and were excluded from the analyses. Resident

level variables that may confound the relationship between race and receipt of vaccine include sex, age, level of education, per diem payment reported for each of Medicare and Medicaid, and any source of private pay as a payment source.

Resident level independent variables

Socio-economic status: Covariate or confounder of race?

In two of the three dissertation aims race is examined at the individual level. To appropriately assess race with vaccination status, adjustment should be made for confounding variables. By definition, confounding factors explain or produce all or part of the difference between the measure of association (e.g., race) and the measure of effect (e.g., vaccination) that would be obtained with a counterfactual ideal.[99] Using directed acyclic graphs to assess confounding would show that a confounder of race and vaccination status would 'point to' or 'cause' both measures. Therefore, how race is viewed in this context necessitates a definition of the construct. The dissertation aims are examining receiving, refusing, and offering of the influenza vaccine. This is a behavioral or social construct, not a biological measure of effect. Therefore the appropriate concept of race for this work is that of social constructionalists. It suggests that human beings' concepts of race do not occur in a social vacuum; social environments are important to explain the content of our concepts of race.[100] For our population, for assessments in the MDS according to the state operations manual, race is supposed to be self-reported. Socio-economic status measured by characteristics such as education and type of insurance are likely partial mediators (i.e., indirect effects) in the relationship between race and receipt of vaccine.[101]

Resident level confounders

Although more studies address the dominance of women in the care-giving role than in receiving care, suggesting that women are much more likely to be caregivers than men,[102] current and future projections suggest than women will continue to surpass men in terms of both longevity and morbidity. Thus, given that compared with men, older women have higher rates of chronic illnesses, longer life expectancy, and lower marital rates, they are more likely than men to need nursing home care.[103] National statistics confirm that the largest users of nursing home care are women (NNHS in 2004: 74.4%;[62] MDS 2005-2006: 68.0%).[46] The NNHS includes non-CMS certified facilities (3% of U.S. nursing home residents) and hospital-administered facilities which may contribute to the gender difference in data sources.

A study that examined differences in health care needs and service utilization of women of color in nursing homes found that African American women were younger than the overall average for women (80 vs 83 years) and Blacks were the most likely to have Medicare compared with the other groups of women.[103] For health needs measures, short-stay African Americans were generally healthier than long-stay residents. Therapy use was high for African Americans during the first year of admission but there was a significant decrease for residents in the facility greater than one year. Because age and gender are also strongly associated with entrance to a LTCF by race and vaccination status, these factors are also considered confounders of the relationship.

County data

Contingency theory is a class of behavioral theory that claims that there is no best way to organize a corporation, to lead a company, or to make decisions. Instead, the optimal course of action depends upon the internal and external situation. Some long-term care researchers have used this theory to test variation in racial/ethnic disparities in quality of care as a function of nursing home structures and process and community context.[80] Results of that study suggest the community context of the nursing home does affect the quality of care of its residents. Therefore, county-level data will be included in facility level analyses (aims 2 and 3), such as median income and median level of education. Other county level data will be assessed.

CMS-CDC Standing Orders Project: Barriers to SOPs, influential authorities, and racial composition of the LTCF, 2000-2002

Study design

The Immunization Standing Orders Program Project was a demonstration project conducted collaboratively by the Centers for Disease Control and Prevention (CDC), the Centers for Medicare & Medicaid Services (CMS), and CMS' Quality Improvement Organizations (QIO). QIOs are the quality assurance arms of CMS and conduct quality improvement activities in a variety of settings. The goal of the project was to have QIOs promote the use of standing orders programs among nursing facilities to increase immunization coverage among residents.

Intervention: Implement standing order programs in nursing homes

Quality Improvement Organization's role in intervention

CDC surveyed the QIOs about interventions they used to promote standing orders for immunizations. The actual intervention to promote SOPs and immunizations was implemented by the QIO in each 'intervention' state. The QIOs were given flexibility as to what strategies to use. Surveys were conducted of each QIO after the intervention period including questions about what strategies had been implemented to promote immunizations; 1 survey was conducted by CDC and the other by an independent contractor. These survey responses were combined for analysis. Another survey directed at the LTCFs was also conducted by the independent contractor asking what type of activities had occurred in the facility during the intervention period, including contact by the QIO and resources provided by the QIO. QIOs were responsible for onsite data collection and program

promotion. The project was considered program evaluation and therefore did not require Institutional Review Board review.

Study population

Fourteen states participated, including nine intervention states and five control states. Twenty facilities were selected in each state, with five facilities in each intervention state chosen to be controls to assess secular trends. No states were known to have laws or regulations restricting the use of SOPs before the start of the project. Facilities were selected using a stratified random sampling design, including facility size and the type of immunization program (oversampled for facilities with immunization standing orders).

Residents eligible for inclusion lived in the facilities for any period of time during the influenza season from November 1 through January 31; Baseline residents during 2000-2001 and post-intervention residents during 2001-2002. In both years 100 residents (or all residents in facilities with < 100 residents) were randomly chosen from each facility and immunization histories were collected through on-site and archived chart abstractions.

Intervention states

The nine intervention states included DC, FL, HI, ID, KY, MA, MN, MT, NM. The intervention states were selected by CMS administratively, based on the QIO's rating of the Immunization Standing Orders Program Project as a high priority.

Control states

The five control states included OH, PA, WI, SC, NV. Control states were selected by CDC using CMS's criteria, that is, whether the QIOs rated the project as a lower priority (and were not selected by CMS) and by diversity.

Four sources of data collected

Survey instrument

The self-administered survey included 35 questions about LTCF structural characteristics as well as policies and procedures, including immunization program for residents and offering of vaccine for facility personnel, outbreaks of influenza among residents, source of vaccines, vaccine storage, immunization documentation, barriers to immunizations, method of obtaining consent from residents or their guardians, and procedures in the facility's written protocol for immunizations.

Immunization program activities were categorized as "SOP," "Advanced orders," or "Individual orders." "SOP" is an institutional policy which authorizes appropriate nursing or pharmacy staff to immunize residents by institution- or medical director-approved protocol without the need for a written or verbal order or an exam from the personal physician. "Advanced orders" are a policy for one physician to authorize appropriate nursing staff to immunize residents by his/her approved protocol without the need for a written or verbal order or an exam from the personal physician. "Individual orders" include preprinted admission orders (PPAO) (i.e., standardized forms included in admission package for personal physician signature which may address future as well as current vaccination needs), reminders/education (procedures in place for educating and/or reminding physicians and residents on importance of vaccinations, and require physician's

order for each immunization), and usual care (residents are immunized upon request and/or upon personal physician's individual discretion, and require physician's order for each immunization).

Data collection

QIOs were responsible for onsite data collection and program promotion. Surveys were administered by and returned to the QIOs and subsequently forwarded to the CDC. Surveys were then double-entered by a contractor hired by the CDC.

Facility administrative data (OSCAR)

OSCAR is an administrative database containing information on all Medicare or Medicaid licensed LTCFs in the U.S. Independent variables included ownership (government, nonprofit, or proprietary), facility size (i.e., number of beds), if the facility had any substandard assessments,[104] if the facility was hospital-administered, type of facility (i.e., skilled nursing facility or nursing facility-Medicare and/or Medicaid certified), and if the facility was independent or part of a multi-facility chain.

Resident data (MDS)

MDS is part of the resident assessment instrument (RAI) completed by nurses and used for assessment and care screening; it is required by the Omnibus Budget Reconciliation Act of 1987 (OBRA 87) for all nursing home residents.[105] Assessments of residents are conducted at various times including admittance to LTCF, annually, if a significant change occurs, discharge from LTCF, and at other times as required by Medicare or the state. For all residents with immunization

data, we obtained MDS data from the most current and/or most complete assessment conducted. Data included gender, race, psychiatric disease, cognitive impairment (e.g. no short-term memory and/or difficulty in daily decision-making), clarity of speech, neurological problems, any special treatments required, sensory diseases (e.g. cataracts, glaucoma, macular degeneration), pulmonary disease, cancer, infections (e.g. HIV, TB, STDs, pneumonia), unstable conditions (e.g. acute episode of chronic problem or conditions that make resident's behavior unstable), end of life, potential to be discharged, accidents (fell in the LTCF in the past 30 days or had a fracture in the past 180 days of assessment), use of 9 or more medications, urinary tract infections, difficulty eating, pressure ulcers, and diabetes.

Using MDS data, we also examined the case mix index (CMI), which is a measurement used to identify patient characteristics associated with measured resource use.[106] Because the CMI includes variables such as any special treatments required, sensory diseases, clarity of speech, and difficulty eating, these variables were not entered into the final models with CMI. Although psychiatric disease and cognitive impairment are used in a limited way in determining the CMI, we did include them in our model because they are excluded from some of the CMI categories. Because the average range of CMI (average cost) has been reported to be 0.80 to 1.10,[106] we used 1.0 as our cutoff point to analyze CMI, classifying CMI <1.0 as low resource use and CMI ≥ 1.0 as high resource use.

Medical chart abstraction

Immunization status

Because this study was conducted prior to immunization status being collected on the MDS, we conducted chart reviews. CMS provided a list of all patients residing in the selected LTCFs during the influenza season from November, 2000 through January, 2001; from this list, we sampled 100 residents randomly from each LTCF. If the LTCF had less than 100 residents, all were included. This list of patients was taken to each of the sampled LTCFs and a chart review was conducted by the QIO to ascertain documentation of immunization. Influenza vaccination status was determined by evidence of receiving the vaccine in during the 2000-2001 influenza season, whereas pneumococcal vaccination status was determined by any evidence of receiving the vaccine in the past. To obtain accurate vaccination status, all vaccination sources were reviewed including the patient's chart, the medication administrative record (MAR), the vaccine administration record (VAR), and log books where available.

CHAPTER 6 DOES FRAILTY DRIVE THE RACIAL GAP IN INFLUENZA VACCINATION WITHIN NURSING FACILITIES IN MICHIGAN, 2005-2006?

Background: In Michigan, racial differences *within* nursing homes were reported in receipt of the influenza vaccine, refusals, and in being offered the vaccine.[89] One study found Black nursing home residents enter the facility in worse condition than their White counterparts.[90] Another study found that frailty was negatively associated with receipt of influenza vaccine among healthy community-dwelling seniors.[16]

Objective: To determine if residents' health condition modifies the effect of the measure of race in refusing, being offered or receiving vaccination among nursing home residents in Michigan.

Methods: We examined data from the Minimum Data Set (MDS) for all residents in Michigan from October 1, 2005 through March 31, 2006. Facility-level data from the Online Survey Certification and Reporting (OSCAR) database were merged with the MDS data. Analyses included polytomous multilevel models assessing frailty measured with the Cognitive Performance Scale (CPS), the Activities of Daily Living (ADL) scale, and the Changes in Health, End-stage disease and Symptoms and Signs (CHESS) score as contributing to racial differences in vaccination within nursing homes.

Results: At the individual level in the overall population, the White-Black (W-B) difference in vaccination (8.5 percentage points) did not narrow by frailty status for any of the 3 scales we examined (range: 6.7 to 10.0 percentage points). However, in

stratified analyses by proportion Black residents in the nursing home, in homes with <5% Blacks the median W-B gap in vaccination increased when comparing non-frail to frail (CPS) residents: from 4.4 to 14.5 percentage points; ADL: 3.6 to 8.7 percentage points; and CHESS: 4.1 to 9.4 percentage points; frail Blacks in those homes had higher likelihoods of not being offered the vaccine than frail Whites (CPS: 22.5 vs 13.9; ADL: 19.1 vs. 13.2; CHESS: 21.1 vs. 13.8). Among residents of nursing homes with ≥50% Black residents, the W-B gap in vaccination decreased with increasing frailty (CPS: 8.7 to 0.8 percentage points; ADL: 9.3 to 2.1 percentage points; and CHESS: 6.7 to 4.6 percentage points); frail Whites in those homes had higher median likelihoods of not being offered the vaccine than frail Blacks (CPS: 42.0 vs 39.3; ADL: 48.1 vs. 45.2).

Conclusions: Frailty was associated with the racial gap in vaccination in that frail residents of the minority race in the nursing home are less likely to be offered the vaccine. In addition, Blacks are more likely than Whites to be in the minority in a nursing facility and homes where Blacks are in the majority are overall lower in vaccination coverage. Nursing homes with the lowest levels of offering vaccine should be targeted for implementing evidence-based vaccination strategies to increase vaccination coverage for Black and White residents.

INTRODUCTION

For many years the influenza vaccine has been recommended for high-risk groups, including nursing home residents and persons with chronic underlying conditions.[66] In a study we conducted examining influenza vaccination in nursing homes in Michigan, racial differences *within* nursing homes were reported in receipt of the vaccine, refusals, and in being offered the vaccine.[107] After statistical control for known confounders and adjustment for multiple levels in the analysis, the gaps persisted. The adjusted median range of inequity (White – Black) *within* homes stratified by proportion Black residents in the facility was 5.1 to 7.1 percentage points.

One hypothesis to help explain this finding is that Black residents are less healthy and therefore less likely to be vaccinated when compared to White residents of the same facility. Evidence supporting this hypothesis includes findings from one study that healthy community-dwelling elderly people preferentially seek vaccination.[16] While frailty may be inversely associated with receipt of influenza vaccine among adults living in the community,[16] this association may not hold for adults in nursing homes. However, limited evidence from an intervention study does support this. Among the approximately 20,000 nursing home residents sampled in 14 states, the 2% of the residents who were near the end of life had statistically lower vaccination coverage than residents not reported to be near end of life (34% vs 59%, $p<.01$).[12] Also in that study, 24% of residents had any injury or fall during the past 180 days of their assessment; among this group, 50% received the

influenza vaccine during the influenza vaccination season, whereas 61% of the residents who did not have a fall or injury received the influenza vaccine.[12]

Whether health status among nursing home residents varies by race remains inconclusive. A study conducted in 2000 reported the "average nursing-home case-mix acuity for African Americans and Caucasians were essentially identical,"[108] but another study conducted at the same time found that Black nursing home residents enter the facility in worse condition than their White counterparts.[90]

Inconsistency among minority population exists for mental illness (frailty measured by cognitive functioning) as well. Although studies have found that Blacks were not at higher risk for psychiatric disorders compared to Whites,[109] even after controlling for variations in socioeconomic conditions and health status, the proportion of Blacks receiving mental healthcare is only half that of Whites.[110] Studies have shown that Blacks are less trusting of healthcare providers[111] and are less likely to have insurance,[112] and could therefore be under-diagnosed. In our previous study residents with psychiatric problems (40%) had much higher vaccination status than those who did not (64% vs 55%, $p<.001$) and so did residents with cognitive impairment (79% of residents) (63% vs 40%, $p<.001$). [12] Thus mental illness has the potential to modify the effect of race on vaccination status.

Therefore we hypothesized that the racial gap in refusing, being offered or receiving vaccination among nursing home residents in Michigan can be explained by differential health condition between Blacks and Whites. We used measures of

clinical, mental, and physical frailty reported for nursing home residents to the Centers for Medicaid and Medicare Services' (CMS).

METHODS AND MATERIALS

Study population

During the 2005-2006 influenza vaccination season, there were 426 Medicare- and Medicaid-certified nursing facilities in Michigan. Of these, 18 were hospital-owned, post-acute recuperative facilities serving mainly Medicare-eligible residents. Since the focus of our study is on the traditional nursing home population, these hospital-based facilities and residents were excluded from the analyses. In addition, we included only residents from racially mixed nursing homes (n=291 facilities out of 403) because the objective of our analysis was to examine the Black deficit in vaccination coverage within nursing homes.

To identify a single assessment for residents with multiple assessments, we used probabilistic software, LinkPlus.[113] From October 1, 2005 through March 31, 2006, 72,458 resident assessments in racially mixed homes represented 66,895 separate residents. This includes all residents who ever lived in a *racially mixed* nursing facility in Michigan during the study period.

Resident-Level Data

Nurses conduct resident assessments at admission to and discharge from the LTCF, annually, when a significant change occurs, and according to Medicare or state requirements. The assessments are housed in the CMS' Minimum Data Set (MDS). Nurses record these assessment and care screening data in the resident assessment instruments (RAI) for all residents, pursuant to the Omnibus Budget Reconciliation

Act of 1987 (OBRA 87). [105] For all those residents with immunization data, we obtained MDS data from the most current and/or most complete assessment conducted. Other data included level of education, gender, age, primary payment source, and race. Instructions for completing the residents' assessments includes reporting the race as a category choice 'within which the resident places self.'[114] The RAI has one variable for race/ethnicity with 5 category responses: 1) American Indian/Alaskan native, 2) Asian/Pacific Islander, 3) Black, not of Hispanic origin, 4) Hispanic, and 5) White, not of Hispanic origin. Residents whose race was reported as other than White or Black comprised < 2% of the nursing home residents in Michigan and were excluded from the analyses.

Frailty Measures appropriate for nursing home residents

Cognitive Frailty

The MDS Cognitive Performance Scale (MDS-CPS) is based on 5 MDS items and classifies residents into 7 cognitive performance levels from 0 to 6.[2] Residents were thus classified: 0 or intact if they had independent cognitive skills for decision making; 1 or borderline intact if they had modified independent cognitive skills for decision making; 2 or mild impairment if they had moderately impaired cognitive skills for decision making and can make themselves understood; 3 or moderate impairment if they had moderately impaired cognitive skills for decision making and can usually make themselves understood; 4 or moderately severe impairment if they had moderately impaired cognitive skills for decision making and can sometimes make themselves understood; 5 or severe impairment if they had severely impaired cognitive skills for decision making and were not totally

dependent on staff for eating in the past 7 days of the assessment; and 6 or very severe impairment if they were comatose or they had severely impaired cognitive skills for decision making and were totally dependent on staff for eating or did not eat in the past 7 days of the assessment.

Physical frailty

The MDS ADL—Long Form is a measure including 7 ADLs: 1) dressing; 2) personal hygiene; 3) toilet use; 4) locomotion on unit or how the resident moves between locations including rooms on the same floor; 5) transfer or how the resident moves between surfaces such as beds and chairs; 6) bed mobility or how the resident moves to and from the lying position; and 7) eating. Each of the 7 ADLs can be scored from 0 to 4 so the measure is a scale from 0 to 28. The scores for each ADL include 0= independent; 1=needs supervision; 2= needs limited assistance; 3= needs extensive assistance; and 4=total dependence or the activity did not occur. [5]

Clinical Frailty

The Minimum Data Set-Changes in Health, End-stage disease and Symptoms and Signs (MDS-CHESS) score is a composite measure focused on changes in health, end-stage disease, and symptoms and signs of medical problems.[1] The MDS-CHESS is a 6-point scale, ranging from 0 (no instability) to 5 (high instability). The scale is created from four components. Individuals receive a score of 0 to 2 for the following 5 symptoms: dehydration, shortness of breath, vomiting, weight loss, or leaves $\geq$ 25% of food uneaten (0 for no symptoms; 1 for 1 symptom present; or 2 for $\geq$ 2 symptoms). Individuals receive an addition of 1 for each of the following: end-stage disease, decline in ADLs in the past 90 days (or since the last assessment if < 90

days), and decline in cognition in the past 90 days (or since last assessment if < 90 days). The CHESS score has been found to be a strong predictor of mortality, independent of age, gender, cognitive impairment, physical impairment (ADLs), and do-not-resuscitate (DNR) orders. The CHESS score is more predictive of mortality than the CPS or ADL scales.[1]

Vaccination Status

The immunization supplement to the assessment instrument asks, "Did the resident receive the influenza vaccine in this facility for this year's influenza season (October 1 through March 31)?" The next question asks, "If influenza vaccine was not received, state reason: 1) not in facility during this year's flu season; 2) received outside of this facility; 3) not eligible; 4) offered and declined; 5) not offered [other]; and 6) inability to obtain vaccine." [Figure 5-2] Because most residents underwent multiple assessments, we used an algorithm to base the reasons for being unvaccinated. [Figure 5-3] We categorized residents as vaccinated when the report indicated they received the vaccine in the facility or outside the facility. Residents were categorized as not offered the vaccine if they were not in facility during this year's flu season, were ineligible, were not offered [other], or the facility was unable to obtain vaccine. The vaccination status reported by each facility was included exactly as that facility reported it.

Facility-level Data

We obtained data from the Online Survey and Certification Assessment Reporting System (OSCAR) submitted during the influenza season from CMS. OSCAR, a federal administrative database, contains structural, staffing and other

information on nursing facilities. OSCAR includes data for all CMS-certified nursing homes. State survey and certification agencies collect the data, comprising part of the annual nursing home certification and recertification process. Each facility completes a standardized form about the facility characteristics, e.g., number of beds, affiliation, and staffing levels. State surveyors review the form and enter the data into the OSCAR database. State surveyors also visit each facility and decide whether the facility meets each standard. We merged these data with the residents' MDS data by each facility of residence.

Reported facility-level confounders of interest include the number of residents in the facility, the proportion of Black residents in the facility, the number of nurse full-time equivalents, the type of ownership, the affiliation with a chain, the CMS facility certification status (i.e., skilled nursing facility or nursing facility-Medicare and/or Medicaid certified), the proportion of residents on Medicaid, and the status of compliance with program requirements for Medicare and/or Medicaid certification.

Racial Composition of the Facility

To assess racial differences in vaccination within and between nursing homes, we stratified facilities by percent of Black residents: 0.1% to 4.9%, 5% to 19.9%, 20% to 49.9%, and $\geq$ 50%. Rather than using quartiles, we chose these cutoffs to enable us to examine nursing homes with large proportions of Black residents (e.g., 5%-19.9% and 20%-49.9%) and the majority ($\geq$50%) Black

residents separately. Unlike quartiles that change across populations, these cutoffs can be used to compare with other populations.

Confounders and Missing Data

Race and vaccination status data were available for all residents in the study, but 4,697 (6%) were missing data for one or more of the frailty scales and were therefore excluded from the multilevel models. Resident-level confounders of interest include sex, age, and other variables related to socioeconomic status.

Statistical Analysis

We present descriptive analyses examining vaccination coverage received, refused, and not offered (includes contraindicated, <2%) by race in facilities grouped by percent of Black residents.

Frailty, defined by the three scales individually, was assessed as an effect measure modifier of race on receipt of vaccine. We used multilevel analyses to obtain adjusted probabilities for vaccination by race, that included the three scales measuring frailty and the following confounders: age, gender, level of education, length of stay, Medicaid payment, Private payment, number of residents in the facility, proportion Black residents in the facility during the influenza season, facility's affiliation with multi-facility chain, type of facility ownership, type of CMS certification, number of nurse full-time equivalents, compliance with program requirements for Medicare and/or Medicaid certification, and proportion of residents on Medicaid. We categorized the frailty scales into clinically meaningful groups. We then assessed multiplicative interactions between race and frailty to

determine if not being offered the vaccine versus receiving the vaccine and/or refusing the vaccine versus receiving the vaccine varied by race within frailty groups. Interaction of race and frailty was assessed for all three scales in 15 multilevel polytomous models, assessing the effect modification of frailty with race for each frailty scale in the overall population (three models) and within each of the four strata of nursing homes (12 models). To appropriately assess the effect of frailty on race, prevalence ratios of higher frailty to lower frailty within each race were assessed. This method of assessment was used because according to the counterfactual assumption, Black residents are not exchangeable with White residents.[115] The adjusted probabilities reported are for the 'average' Black and White individual residents, holding nursing home constant [See Appendix 1 for interpretation of estimates from the multilevel model].

To assess vaccination coverage *within* facilities, we used estimates from the polytomous multilevel model to calculate probabilities of receipt of vaccine, refusing vaccine, and not offering the vaccine, for both Whites and Blacks in each nursing home. Data for the individual nursing homes were categorized according to percent Black nursing home residents in the facility. To control for variability of vaccination *among* all nursing homes, we included random effects (i.e., random intercepts) in the multilevel model that included the 291 racially mixed facilities.

The institutional review boards of the Centers for Disease Control and Prevention and Emory University approved this study.

RESULTS

Racial distribution among facilities

Of the 66,895 residents in the population, 11,756 (17.6%) were Black and 55,139 (82.4%) were White. There was no racial difference in the proportion of residents who resided in >1 nursing facility during the influenza vaccination season (approximately 8%).

Frailty

The median MDS-CHESS score of 1 did not differ for the population overall, for White and Black nursing home residents, and among those who received the influenza vaccine, refused the vaccine, and were not offered the vaccine. Likewise, the median MDS-CPS score of 2 did not differ for the population overall, for White and Black nursing home residents, and among those who received the influenza vaccine, refused the vaccine, and were not offered the vaccine. Similarly, the median MDS-ADL—Long Form score of 18 did not differ for the population overall, for White and Black nursing home residents, and among those who received the influenza vaccine, refused the vaccine, and were not offered the vaccine. Each level within frailty scores varied little by race. [Tables 6-1a, 6-1b, 6-1c]

Further breakdown of the frailty scores by quartiles for the ADL scale and into clinically meaningful groups for the CHESS and CPS scales by race and vaccination status also show little variation overall in the population. [Table 6-2]

Vaccination status

The unadjusted vaccination coverage for Michigan residents of racially mixed homes (n=291) was 56.9% (42.6% for Black residents and 59.9% for White residents). Higher proportions of Black residents were not offered the vaccine (40.2% vs 26.7%) and refused the vaccine (17.1% vs 13.4%), compared with White

residents. Results from the adjusted multilevel model before accounting for frailty were somewhat higher for vaccination coverage (53.0% for Blacks and 61.5% for Whites). The adjusted probability of not being offered the vaccine was 28.3% for Blacks and 24.0% for Whites; the adjusted probability of refusing the vaccine was 18.7% for Blacks and 14.5% for Whites.

Effect modification of frailty on race in receipt of vaccination

In the overall population before stratifying nursing homes by proportion Black residents, we examined the interaction between the three frailty scales with race in three separate models, individually [Table 6-3]. The W-B difference overall did not vary much by frailty scale, 8.4-8.7 for CHESS, 6.7-10.0 for CPS, and 7.4-9.6 for ADL, and no trend was ascertained.

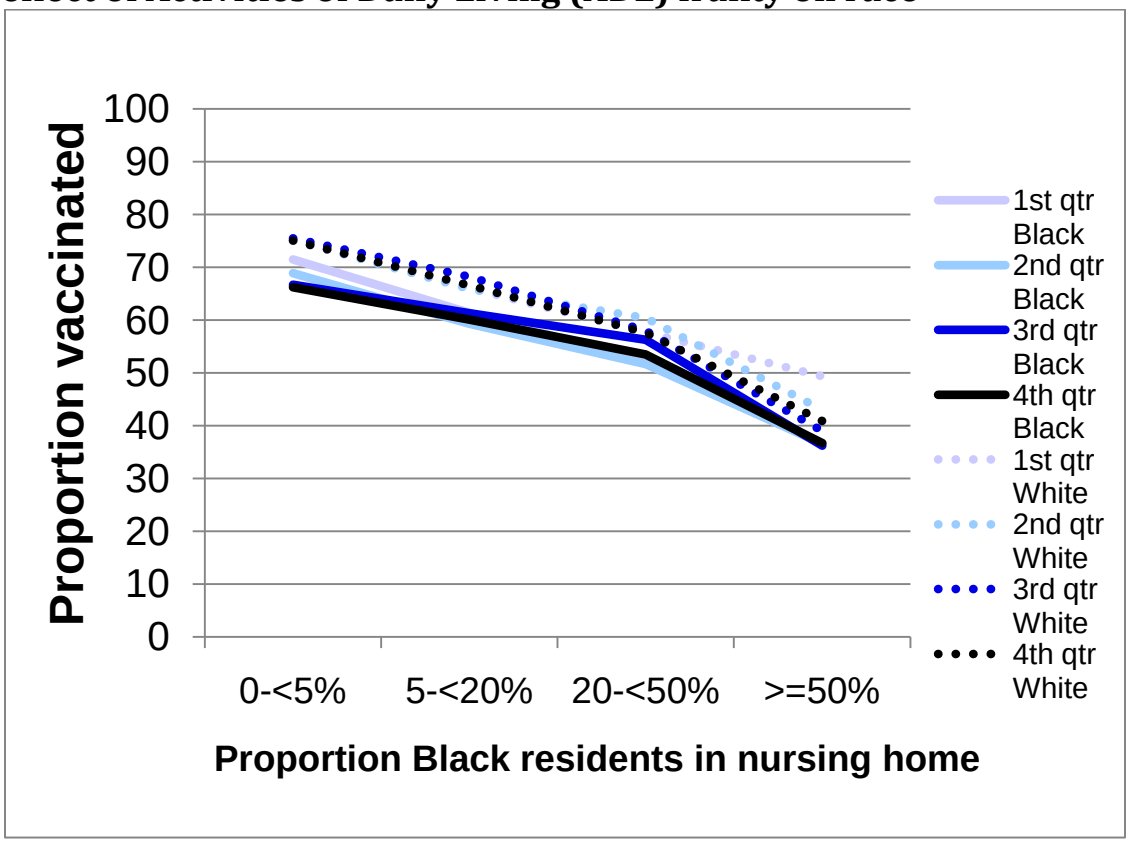
For frailty measured by the cognitive performance scale, in the predominantly Whites homes (0.1%-4.9% Blacks) the prevalence ratio of vaccination is lower among more highly frail Blacks (.846) than among the more highly frail Whites (.994). [Table 6-4a] In the majority Black homes ($\geq$ 50%) the prevalence ratio of vaccination was lower among frail Whites (.978 and .884) than it was among frail Blacks (1.080 and 1.061). Among the 118 nursing homes with 0.1%-4.9% Black residents, the prevalence ratio of vaccination is lower among more highly frail Blacks (.962 to .926) according to the ADL frailty scale. [Table 6-4b] Similarly, among the 41 homes with $\geq$ 50% Blacks, the prevalence ratio of vaccination is lower among highly frail Whites (.886 to .824) according to the ADL frailty scale. For frailty measured according to the CHESS score, in the

predominantly Whites homes (0.1%-4.9% Blacks) the prevalence ratio of vaccination is lower among more highly frail Blacks (.933) than among the more highly frail Whites (1.003). [Table 6-4c] In the majority Black homes (≥ 50%) the prevalence ratio of vaccination was lower among frail Whites (.999) than it was among frail Blacks (1.045).

Vaccination by race within facilities by racial composition of the facility

Adjusted vaccination coverage was lower among residents of nursing homes with higher proportions of Black residents, regardless of race or frailty. [Figures 6-1.1 – 6-1.3] Adjusted probabilities of vaccination by race were stratified by proportion of Black residents in the nursing home. [Tables 6-5a to 6-5c] The estimates come from polytomous multilevel models [Appendix 1]. Although the dependent variable in the model was at the resident level -- vaccination status -- the inclusion of random effects provides estimates at both the facility and resident levels. For example, the median probability of vaccination for the 40 facilities with > 50% Black residents was 39.2% for all borderline or intact (i.e., non-frail according to CPS) Black nursing home residents, controlling for the facility average (of the facilities in *that* stratum) of the confounders listed. [Table 6-3a] The median probability of refusing vaccination for the 33 facilities with 20 to < 50% Black residents was 10.4% for all highly frail (according to CHESS) White residents, controlling for the facility average of the confounders. [Table 6-3c]

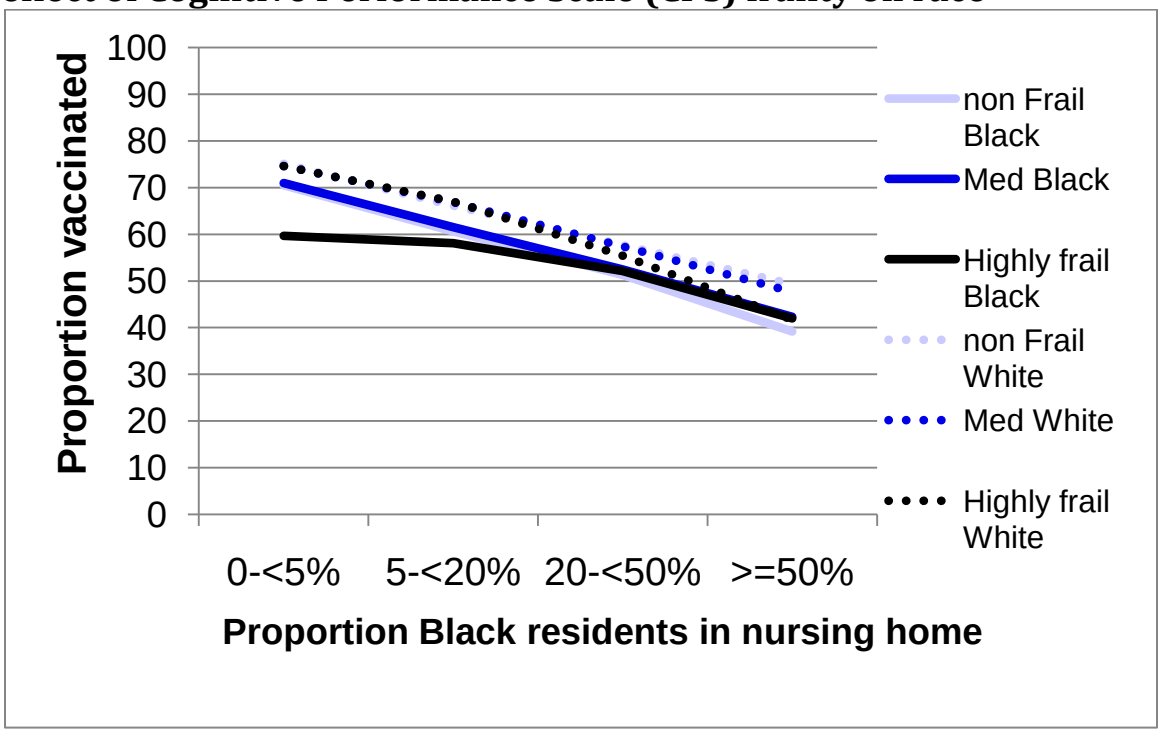
Figure 6-1.1*Within* Facilities: Influenza vaccination coverage by effect of Activities of Daily Living (ADL) frailty on race



In the facilities with 0.1% to <5% Black residents, the W-B difference in vaccination was more narrow among non-frail or borderline/intact residents according to the CPS and CHESS scales and in the first quartile of ADL scale (W-B: CPS: 4.4; ADL: 3.6; and CHESS: 4.1). Within those 118 facilities with fewer than 5% Black residents, the most highly frail Black residents according to the 3 frailty scales had much lower vaccination coverage than their frail White counterparts (W-B: CPS: 14.5; ADL: 8.7; and CHESS: 9.4). The W-B differences in those nursing homes among the most highly frail residents was reportedly due to large median W-B differences in not being offered the vaccine (W-B: CPS: -8.7; ADL: -6.0; and CHESS: -7.2). The

same trend was reported in nursing homes with 5% to < 20% Black residents for all three scales.

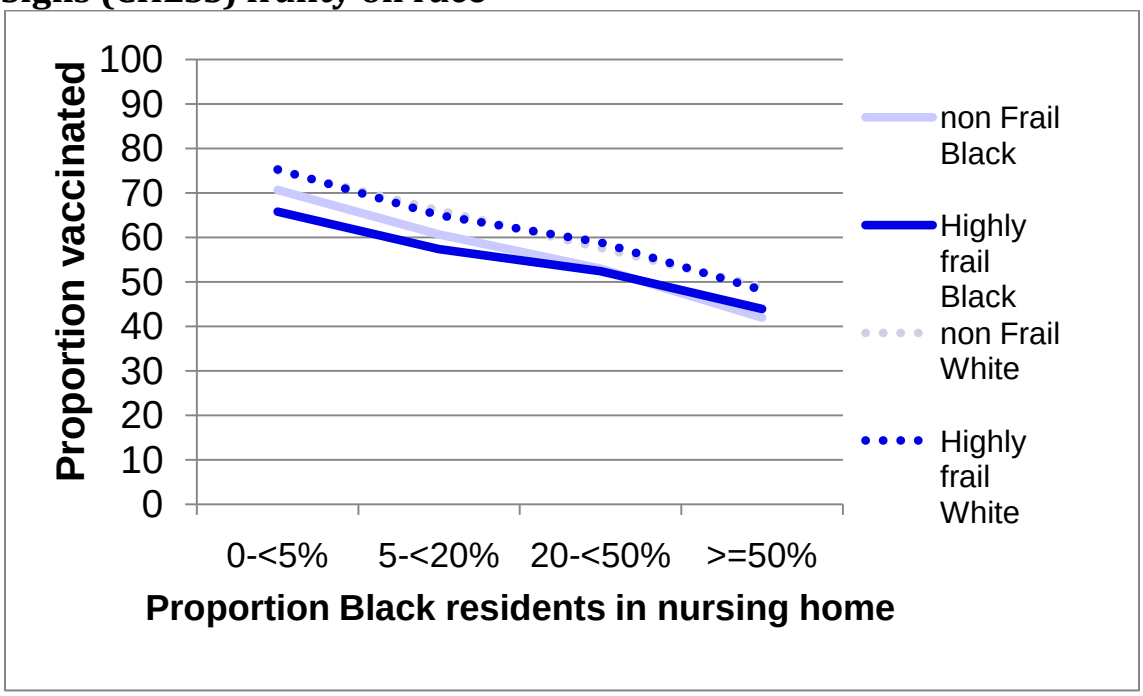
Figure 6-1.2 *Within* Facilities: Influenza vaccination coverage by effect of Cognitive Performance Scale (CPS) frailty on race



Among residents of nursing homes with >50% Black residents, the W-B difference in vaccination was the greatest among non-frail or borderline/intact residents according to the CPS and CHESS scales and in the first quartile of ADL scale (W-B: CPS: 8.7; ADL: 9.3; and CHESS: 6.7) compared with their frail counterparts. Within those 40 facilities in which Blacks were in the majority (i.e., >50%), the most highly frail White residents according to two of the three frailty scales had lower vaccination coverage than their less frail White counterparts, but still higher vaccination coverage than frail Blacks residents (W-B: ADL 4th quartile: 2.1; and CHESS highly frail: 4.6). The more narrow W-B differences in those nursing homes among the most highly frail residents compared with less frail residents was

associated with higher median probabilities of not being offered the vaccine among frail Whites than among frail Blacks for two of the three scales (W-B: CPS: 2.5; ADL: 2.7). The same trend in W-B vaccination difference was found in nursing homes with 20% to <50% Black residents for the CPS and ADL scales, but for the CHESS scale the racial gap decreased among the more frail White and Black residents.

Figure 6-1.3 *Within* Facilities: Influenza vaccination coverage by effect of Changes in Health, End-stage disease and Symptoms and Signs (CHESS) frailty on race



The W-B difference in refusing the vaccine (<6%) did not vary much according to the CPS and CHESS scales in any of the nursing homes; Blacks consistently reported higher levels of refusing than Whites, except in homes with > 50% Black residents among residents in the 1st quartile of ADL (median W-B difference in refusing: 0.9 percentage points).

DISCUSSION

High frailty was associated with a narrow W-B difference in vaccination among residents living in nursing homes in which Blacks were in the majority (i.e., > 50% Black residents.) The reason for this small racial difference was primarily due to lower levels of offering vaccine to frail White residents, compared with less frail White residents according to the CPS and ADL frailty scales. A similar trend, reversing the groups by race, was found within the 118 predominantly White homes (i.e., 0.1% - < 5% Black residents). The racial gap (W-B) in receipt of vaccine was narrower among the healthiest residents according to the three frailty scales in these predominantly White homes because frail Black residents in those homes were less likely to be offered the vaccine. The W-B difference in refusing vaccine varied little by level of frailty for the CPS and CHESS scales within the 4 strata of nursing homes but did vary for the ADL scale in the racially mixed nursing homes with the most and the least Black residents. Frailty did not modify the effect measure of race on not being offered or refusing the vaccine when comparing all residents in the population, controlling for facility and other confounders.

Although a previous study found that frailty confounds the relationship between receipt of vaccine and influenza-related disease among community-dwelling seniors,[16] race was not considered to be an important confounder of that relationship. Our results do suggest frailty modifies the effect measure of race on vaccination coverage *at the facility level in homes stratified by proportion of Black residents*, but not at the individual level in our overall population. One study found that Blacks are more likely to desire aggressive treatment at end of life than Whites,[116] but the racial differences in refusing the vaccine at various levels of frailty

remained constant for two of the frailty scales. The finding that a frail resident who is in the racial minority of the nursing home was less likely to be vaccinated than the frail resident who is in the racial majority of the same nursing home was more likely due to not being offered the vaccine rather than to refusing the vaccine. This finding is consistent with the IOM report on racial disparities in health outcomes that found patient-level factors (including patient preferences and treatment refusal) were thought to contribute the least to disparities.[72]

Although some studies have been criticized for conflating race with socio-economic indicators, obscuring their utility in outcomes research,[117] we controlled such factors separately in our analyses. For example, level of education of Black and White residents was similar in nursing homes with 0.1% to <5% Black residents (data not presented). However, in these 118 nursing homes a larger proportion of Black residents were on Medicaid compared with Whites (26.8% vs 21.6%) and a larger proportion of White residents had private payment as a funding source than Blacks (26.0% vs 18.4%). Residents on Medicaid had higher unadjusted vaccination coverage in our study than did residents with private payment as a funding source (74.3% vs 60.4%) so the finding that frail Black residents were less likely to be vaccinated because they were not offered the vaccine in these homes is troubling. It could be that staff may be less likely to offer the vaccine to frail residents reported to be in the minority race of the nursing home. In fact, according to the IOM, provider stereotyping and bias were reported to be likely influences on health outcomes for minority patients.[72]

In the three strata of homes with < 50% Black residents, the same proportion of Blacks and Whites had Medicare (between 39-42%), but in the homes with ≥ 50% Black residents only 25% of residents of both race groups had some form of Medicare per diem. Although this stratum of homes had the lowest proportion of residents reporting a Medicare per diem (which may be a proxy for short stay (i.e., post-recuperative stay)), almost 50% of all the Black residents in the state or 36.4% of the Blacks on Medicare in the state live in these homes; and reporting a Medicare per diem is also associated with lower likelihood of being vaccinated.[12,118]

We found that in the 251 nursing homes with <50% Black residents, the most frail Black residents according to the CHESS score were less likely to be vaccinated than Black residents who were intact or borderline according to the CHESS score. That is disconcerting in that they are the most vulnerable residents who should be protected against disease. Conversely, vaccination coverage was reportedly higher among the most frail White residents in the homes with <50% Black residents compared with non-frail White residents according to the CHESS score. Further, the socio-economic status of Black and White residents in the 40 homes with ≥ 50% Black residents was nearly identical according to level of education and type of funding with the exception being the proportion of residents with private payment as a payment source (8.6% of Blacks and 12.3% of Whites). Thus in this group of nursing homes the finding that frail White residents were less likely to be offered the vaccine than their Black counterparts and their less frail White counterparts is also disconcerting. We hypothesize that the racial difference in offering the vaccine to frail residents according to the proportion Black residents in the nursing home

may have to do with staff attitudes toward vaccination, particularly the race of the staff and their associated beliefs about race and vaccination near end of life.

In our previous study conducted during 2000-2001 examining end-stage disease or ≤ 6 months to live as a proxy for near end of life, we found the 2% nursing home population in 14 states had statistically significantly lower vaccination coverage than residents not reported to be near end of life (34% vs 59%, $p<.01$).[12] Although this finding motivated the current study, in this study conducted five years later in Michigan we found the 3.2% population near end of life had statistically significantly higher vaccination coverage than residents not reported to be near end of life (62.4% vs 56.7%, $p<.01$). To understand if this inconsistency was due to state variation, we examined the MDS item in the same 14 states during the same time of our current study (2005-2006) and found in contrast to our earlier results that vaccination coverage for those reported to be near end of life was higher than for those reported not to be near end of life (56.3% vs. 54.8%). However, Black residents near end of life compared with those not at end of life had statistically significantly lower vaccination coverage (40.7% vs 42.7%) than their White counterparts (65.5% vs 59.7%). Thus, in our study the quantitative measures of frailty resulted in similar findings as the more subjective measure of frailty. Our results highlight the importance of examining vaccination coverage stratified by facilities by the proportion of Black residents to draw a more specific conclusion than that found by only looking in the overall population without regard to the racial composition of the nursing home.

Although refusing the vaccine did not vary to a sizable extent between the racial groups by level of frailty, 10% of all residents refused the vaccine and approximately 3 percentage points of the W-B difference in receiving the vaccine within nursing homes was due to Blacks refusing vaccination more than their White counterparts. Therefore further research is necessary and may include an intervention study to determine if refusals among Black residents could be lowered by addressing cultural competency of nursing home staff, among other possible reasons for refusals. Studies have found racial disparities in quality of care when staff are racially homogenous in nursing homes with racially mixed residents.[119] Our data, however, do not allow us to examine the role of staff racial composition in relation to resident's race. To lessen refusals of the vaccine, strong recommendations of physicians for vaccination during physician visits could be combined with addressing patients' vaccine-related concerns, as was done successfully in one study of the pneumococcal vaccine among adult outpatients.[120] This approach would be easily adaptable to the nursing home environment. Personalized presentation of information, along with quality assurance of staff communications' skills, would be important training components. Understanding and addressing vaccine-related concerns that may be particular to minorities may prove more effective in reducing inequities for vaccination.

Limitations

A limitation of this study is that the data are cross-sectional during the influenza vaccination season. The date of vaccination was unknown so we could not tie the health condition of the resident to the day of vaccination, per se. However,

because on average residents had > 1 assessment during the study period, we used the record that would indicate the highest level of frailty, to be conservative. Also, the vaccination status reported on the MDS has not been validated so we cannot determine the extent of possible bias using an evidence-based sensitivity analysis.

Conclusions

It is important to understand why frailty is associated with residents' minority status and not being offered the influenza vaccine in nursing homes. Also, frailty contributed little to the racial difference in refusing vaccine. These findings strengthen the case for further research into what *is* driving the racial gap in refusing and not offering the influenza vaccine *within* nursing homes.

Table 6-1a. Clinical Frailty: MDS CHESS score—Changes in Health, End-stage disease and Symptoms and Signs

	0 n=23,551	1 n=20,485	2 n=18,606	3 n=7,664	4 n=2,132	5 n=241
Whites	19,356 (32.4)	16,876 (28.3)	15,240 (25.5)	6,306 (10.6)	1,754 (2.9)	199 (0.3)
Blacks	4,195 (32.4)	3,609 (27.9)	3,366 (26.0)	1,358 (10.5)	378 (2.9)	42 (0.3)

Table 6-1b. Cognitive Frailty: MDS CPS—Cognitive Performance Scale

	Missing n=4,898	0 n=16,988	1 n=6,437	2 n=10,809	3 n=18,507	4 n=6,101	5 n=4,308	6 n=4,631
Whites	4,020 (6.7)	13,874 (23.2)	5,309 (8.9)	8,917 (14.9)	15,273 (25.6)	5,003 (8.4)	3,521 (5.9)	3,814 (6.4)
Blacks	878 (6.8)	3,114 (24.1)	1,128 (8.7)	1,892 (14.6)	3,234 (25.0)	1,098 (8.5)	787 (6.1)	817 (6.3)

Table 6-1c. Physical Frailty: MDS ADL Long Form Scale

	Missing n=4,605	0 n=1,213	1 n=549	2 n=805	3 n=810	4 n=961	5 n=1,008	6 n=1,252	7 n=1,248	8 n=1,590
Whites	3,774 (6.3)	980 (1.6)	451 (0.8)	666 (1.1)	669 (1.1)	778 (1.3)	846 (1.4)	1,062 (1.8)	1,013 (1.7)	1,298 (2.2)
Blacks	831 (6.4)	233 (1.8)	98 (0.8)	139 (1.1)	141 (1.1)	183 (1.4)	162 (1.3)	190 (1.5)	235 (1.8)	292 (2.3)

	9 n=1,536	10 n=2,079	11 n=2,144	12 n=2,819	13 n=2,666	14 n=2,663	15 n=3,066	16 n=3,254	17 n=3,689	18 n=5,008
Whites	1,239 (2.1)	1,714 (2.9)	1,750 (2.9)	2,321 (3.9)	2,224 (3.7)	2,180 (3.7)	2,568 (4.3)	2,664 (4.5)	3,057 (5.1)	4,080 (6.8)
Blacks	297 (2.3)	365 (2.8)	394 (3.0)	498 (3.9)	442 (3.4)	483 (3.7)	498 (3.9)	590 (4.6)	632 (4.9)	928 (7.2)

	19 n=4,860	20 n=3,682	21 n=3,245	22 n=2,785	23 n=2,086	24 n=2,052	25 n=1,742	26 n=1,790	27 n=2,000	28 n=5,472
Whites	3,979 (6.7)	3,028 (5.1)	2,689 (4.5)	2,292 (3.8)	1,716 (2.9)	1,688 (2.8)	1,425 (2.4)	1,439 (2.4)	1,643 (2.8)	4,498 (7.5)
Blacks	881 (6.8)	654 (5.1)	556 (4.3)	493 (3.8)	370 (2.9)	364 (2.8)	317 (2.5)	351 (2.7)	357 (2.8)	974 (7.5)

Table 6-2. Scores on Frailty Measures and Frequencies of Vaccination by race among Residents of 291 Racially mixed Nursing Homes, Michigan, 2005-2006

N=291 racially mixed facilities	All		Race		Vaccination Status			Race					
								Whites			Blacks		
								Vaccination Status			Vaccination Status		
			Whites	Blacks	Vaccinated	Refused	Not Offered&	Vaccinated	Refused	Not Offered&	Vaccinated	Refused	Not Offered&
	N	%	%	%	%	%	%	%	%	%	%	%	%
MDS* Activities of Daily Living (ADL) Scale													
1st quartile	15,288	21.10	21.1	21.3	56.5	14.1	29.4	59.4	13.4	27.2	43.3	17.1	39.6
2nd quartile	18,239	25.17	25.3	24.4	56.8	14.0	29.2	59.9	13.4	26.7	41.4	17.0	41.6
3rd quartile	16,917	23.35	23.3	23.5	57.5	13.9	28.5	60.5	13.1	26.4	43.6	17.8	38.6
4th quartile	17,983	24.82	24.8	25.1	56.7	14.3	29.0	59.7	13.8	26.5	42.7	16.8	40.5
Missing	4,034	5.57	5.5	5.7	56.3	13.6	30.1	59.5	13.0	27.5	41.5	16.4	42.1
Changes in Health, End-stage disease and Symptoms and Signs (CHESS) score													
0-1 (no clinical frailty)	43,898	60.58	60.7	60.2	56.8	14.1	29.1	59.8	13.4	26.7	42.6	17.2	40.2
2-5 (clinical frailty)	28,563	39.42	39.3	39.8	56.9	14.0	29.1	59.9	13.4	26.7	42.7	17.0	40.3
MDS Cognitive Performance Scale (CPS)													
Intact/Borderline	23,681	32.68	32.6	33.2	56.6	14.2	29.2	59.9	13.5	26.6	41.6	17.4	41.0
Mild/Moderate impairment	29,362	40.52	40.7	39.7	57.1	14.1	28.9	59.9	13.4	26.7	43.5	17.1	39.4
Moderately Severe to Very Severe impairment	15,067	20.79	20.8	21.0	56.8	14.0	29.2	59.8	13.4	26.9	43.0	16.9	40.1
Missing	4,351	6.00	6.0	6.1	56.7	13.4	29.9	59.9	12.8	27.2	41.5	16.2	42.3
End-stage disease, 6 or fewer months to live													
Yes	2,168	3.2	3.4	2.3	62.4	14.1	23.5	65.5	13.3	21.2	40.7	20.0	39.3
No	65,400	96.8	96.6	97.7	56.7	14.1	29.2	59.7	13.4	26.9	42.7	17.1	40.1
Resident characteristics: race and vaccination													
Sex													
Female	48,358	66.7	68.1	60.5	59.0	14.1	27.0	61.7	13.4	24.9	44.5	17.4	38.1
Male	24,100	33.3	31.9	39.5	52.6	14.1	33.4	55.9	13.4	30.7	39.9	16.7	43.5
Medicaid as a payment source (per diem)													
Yes	16,157	22.3	20.9	28.7	74.3	12.6	13.1	79.6	10.9	9.5	56.0	18.4	25.6
No	56,304	77.7	79.1	71.3	51.8	14.5	33.7	54.6	14.1	31.3	37.3	16.6	46.1

Table 6-2. Scores on Frailty Measures and Frequencies of Vaccination by race among Residents of 291 Racially mixed Nursing Homes, Michigan, 2005-2006

N=291 racially mixed facilities	All		Race		Vaccination Status			Race					
								Whites			Blacks		
								Vaccination Status			Vaccination Status		
			Whites	Blacks	Vaccinated	Refused	Not Offered&	Vaccinated	Refused	Not Offered&	Vaccinated	Refused	Not Offered&
	N	%	%	%	%	%	%	%	%	%	%	%	%
Medicare as a payment source (per diem)													
Yes	35,580	39.5	40.5	33.4	61.3	14.0	24.7	63.9	13.5	22.6	42.7	17.1	40.2
No	54,543	60.5	59.5	66.6	60.0	57.6	63.0	63.3	11.6	25.1	43.2	16.8	40.0
Private pay as a payment source													
Yes	15,776	21.8	23.6	13.4	60.4	14.5	25.1	62.9	13.9	23.2	40.0	18.9	41.1
No	56,685	78.2	76.4	86.6	55.9	14.0	30.1	59.0	13.2	27.8	43.1	16.8	40.1
Education													
< HS	13,438	18.5	18.4	19.1	57.1	14.0	28.9	60.0	13.4	26.6	44.2	16.5	39.3
HS	19,111	26.4	26.3	26.6	57.2	13.9	28.8	60.3	13.3	26.3	43.0	16.8	40.3
> HS	9,206	12.7	12.7	12.8	55.7	14.8	29.5	58.6	14.1	27.2	42.2	17.7	40.1
Missing	30,706	42.4	42.5	41.6	56.8	14.0	29.2	59.9	13.2	26.9	41.9	17.5	40.7

*MDS = Minimum Data Set

&Not Offered includes: Facility unable to obtain vaccine, resident not offered the vaccine for no reason, resident not in facility during influenza vaccination season according to report but not according to assessment date, and contraindication

Table 6-3. – Adjusted probabilities of overall population racial differences in vaccination, refusing vaccine, and not being offered vaccine

Variable	VACCINATED			REFUSED			NOT OFFERED		
	BLACKS	WHITES	W-B DIFF	BLACKS	WHITES	W-B DIFF	BLACKS	WHITES	W-B DIFF
ADJUSTED PROBABILITY BEFORE EXAMINING FRAILTY	53.0	61.5	8.5	18.7	14.5	-4.2	28.3	24.0	-4.3
SEPARATE MODELS FOR FRAILTY SCALES:									
Interaction									
CHESS SCORE:									
LOW OR GOOD (0-1)	53.1	61.5	8.4	18.6	14.5	-4.1	28.3	24.0	-4.3
HIGH (2-5)	52.4	61.1	8.7	19.1	14.7	-4.4	28.5	24.2	-4.3
CPS SCORE:									
INTACT OR BORDERLINE (0-1)	51.5	61.5	10.0	19.3	14.5	-4.8	29.2	24.0	-5.2
MILD TO MODERATE (2-3)	54.8	61.5	6.7	18.1	14.6	-3.5	27.1	23.9	-3.2
MODERATELY SEVERE TO VERY SEVERE IMPAIRMENT (4-6)	52.0	61.2	9.2	19.2	14.7	-4.5	28.8	24.1	-4.7
ADL SCALE:									
1st quartile (0-11)	54.1	61.5	7.4	18.0	14.5	-3.5	27.9	24.0	-3.9
2nd quartile (12-16)	52.0	61.6	9.6	19.0	14.5	-4.5	29.0	23.9	-5.1
3rd *quartile* (17-22)	54.2	62.8	8.6	19.3	14.1	-5.2	26.5	23.1	-3.4
4th *quartile* (23-28)	53.5	61.6	8.1	18.5	14.9	-3.6	28.0	23.5	-4.5

Note: All multilevel models adjusted for covariates: sex, level of education, Medicaid, Private Pay, Medicare, age, number of residents in the facility, proportion African-Americans in the facility, facility's affiliation with multi-facility chain, type of ownership, type of certification, compliance with program requirements for Medicare and/or Medicaid certification, number of nurse full-time equivalents, and proportions of residents on Medicaid, Medicare, and Private Pay

**Adjusted not offered probabilities also include residents who were contraindicated for the vaccine (1-2%). There were no racial differences in proportions contraindicated.

Table 6-4a. – *Within* Facilities: Influenza vaccination coverage by effect of Cognitive Performance Scale (CPS) frailty on race

% Blacks in facility	Prevalence ratios Medium frail vs non-frail		Prevalence ratios Frail vs non-frail	
	Whites	**Blacks**	**Whites**	**Blacks**
0-<5%	.993 (.993,.994)	1.005 (1.003, 1.008)	.994 (.994, .994)	.846 (.826, .859)
5-<20%	1.010 (1.010, 1.012)	1.012 (1.011, 1.013)	1.013 (1.011, 1.015)	.953 (.948, .962)
20-<50%	.993 (.992, .995)	1.017 (1.014, 1.024)	.962 (.950, .970)	1.014 (1.011, 1.018)
≥ 50%	.978 (.972,.985)	1.080 (1.069, 1.088)	.884 (.854, .911)	1.061 (1.054, 1.072)

Table 6-4b. – *Within* Facilities: Influenza vaccination coverage by effect of Activities of Daily Living (ADL) frailty on race

% Blacks in facility	Prevalence ratios Med-low frail (2nd quartile) vs non-frail (1st quartile)		Prevalence ratios Med frail (3rd quartile) vs non- frail (1st quartile)		Prevalence ratios Frail (4th quartile) vs non-frail (1st quartile)	
	Whites	Blacks	Whites	Blacks	Whites	Blacks
0-<5%	1.001 (1.001,1.002)	.962 (.956, .965)	1.005 (1.004, 1.006)	.938 (.931, .952)	.999 (.998, 1.001)	.926 (.914, .931)
5-<20%	.999 (.999,.999)	.963 (.958, .969)	1.032 (1.027,1.038)	1.000 (.999,1.001)	1.008 (1.007,1.011)	.978 (.973,.982)
20-<50%	1.032 (1.023,1.047)	.996 (.987,1.007)	1.003 (1.001,1.005)	1.076 (1.058,1.095)	.999 (.997,1.000)	1.025 (1.018,1.031)
≥ 50%	.886 (.868,.900)	.975 (.964,.984)	.832 (.787,.862)	.995 (.986,1.001)	.824 (.788,.868)	1.000 (.996,1.004)

Table 6-4c. – *Within* Facilities: Influenza vaccination coverage by effect of Changes in Health, End-stage Disease, and Symptoms and Signs (CHESS) frailty on race

% Blacks in facility	Prevalence ratios Frail vs non-frail	
	Whites	**Blacks**
0-<5%	1.003 (1.002, 1.003)	.933 (.922, .948)
5-<20%	.984 (.982, .987)	.947 (.942, .954)
20-<50%	1.008 (1.007, 1.011)	.988 (.983, .990)
≥ 50%	.999 (.992, 1.003)	1.045 (1.039, 1.051)

Table 6-5a. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Cognitive Performance Scale (CPS): Michigan, 2005-2006

0.1% to <5% Blacks in the nursing homes (n=118)									
Model	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=301	White n=16,769	W-B diff	Black n=106	White n=3,512	W-B diff	Black n=129	White n=5,105	W-B diff
Race and frailty in model, no effect modification	68.5 (63.0-71.1)	75.1 (69.9-77.4)	6.5 (6.1-6.7)	13.6 (12.4-14.8)	10.0 (8.8-10.9)	-3.7	16.5 (13.9-18.7)	14.0 (12.1-16.3)	-2.4
Models with effect modification between frailty and race									
Borderline/Intact	70.5 (65.1-72.7)	75.1 (69.9-77.4)	4.4 (4.2-4.6)	13.2 (11.9-14.3)	10.0 (8.8-10.9)	-3.2	15.2 (12.7-17.2)	14.0 (12.1-16.3)	-1.0
Mild to Moderately Impaired	71.0 (65.5-73.1)	74.6 (69.5-77.0)	3.4 (3.2-3.6)	14.0 (12.5-15.2)	10.6 (9.4-11.5)	-3.4	13.9 (11.7-15.9)	13.9 (11.9-15.8)	<.01
Moderately severe to very severely impaired	59.7 (53.3-62.7)	74.6 (69.5-77.0)	14.5 (14.0-15.1)	16.2 (15.0-17.2)	10.6 (9.4-11.5)	-5.4	22.5 (19.3-25.7)	13.9 (11.9-15.8)	-8.7
5% to <20% Blacks in the nursing homes (n=100)									
	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=1,504	White n=13,388	W-B diff	Black n=515	White n=3,161	W-B diff	Black n=1,199	White n=7,275	W-B diff

Table 6-5a. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Cognitive Performance Scale (CPS): Michigan, 2005-2006

Race and frailty in model, no effect modification	59.9 (53.8-65.0)	66.1 (60.0-70.8)	5.8 (5.5-6.1)	12.3 (10.5-13.2)	9.8 (8.5-10.7)	-2.3	25.7 (21.6-29.0)	22.4 (18.8-26.0)	-3.1
Models with effect modification between frailty and race									
Borderline/Intact	60.6 (54.6-65.8)	66.1 (59.9-70.8)	5.0 (4.8-5.1)	12.2 (10.5-13.0)	9.8 (8.5-10.7)	-2.2	25.0 (21.0-28.3)	22.4 (18.8-26.0)	-2.5
Mild to Moderately Impaired	61.5 (55.3-66.6)	66.9 (60.7-71.6)	5.0 (4.8-5.2)	11.5 (9.9-12.3)	9.2 (8.0-10.1)	-2.1	25.0 (21.0-28.4)	22.3 (18.7-26.0)	-2.6
Moderately severe to very severely impaired	58.1 (51.4-63.3)	67.0 (60.9-71.6)	8.5 (8.0-8.9)	12.0 (10.2-13.1)	9.4 (8.2-10.3)	-2.3	27.9 (23.5-31.4)	21.9 (18.4-25.6)	-5.7
20% to <50% Blacks in the nursing homes (n=33)									
	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=1,108	White n=2,727	W-B diff	Black n=397	White n=635	W-B diff	Black n=1,155	White n=2,088	W-B diff
Race and frailty in model, no effect modification	52.6 (42.0-61.3)	57.7 (47.8-66.4)	4.9 (4.3-5.1)	12.8 (10.1-14.6)	10.7 (8.3-12.1)	-1.8	26.2 (20.0-36.5)	23.0 (17.7-33.1)	-2.6
Models with effect modification between frailty and race									
Borderline/Intact	51.3 (40.8-60.1)	57.7 (47.9-66.8)	6.1 (5.4-6.3)	13.2 (10.4-15.0)	10.7 (8.3-12.2)	-2.1	27.2 (20.7-37.6)	23.0 (17.8-33.1)	-3.5

Table 6-5a. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Cognitive Performance Scale (CPS): Michigan, 2005-2006

Mild to Moderately Impaired	52.5 (41.4-60.9)	57.4 (47.0-65.9)	4.6 (4.1-4.8)	13.4 (10.6-15.2)	11.2 (8.7-12.8)	-1.8	25.9 (19.7-36.1)	22.9 (17.6-32.9)	-2.4
Moderately severe to very severely impaired	52.1 (41.6-60.8)	55.4 (45.7-64.8)	3.2 (2.8-3.3)	13.0 (10.3-14.8)	11.2 (8.8-12.7)	-1.5	26.6 (20.2-36.9)	24.7 (19.0-35.0)	-1.3
> 50% Blacks in the nursing homes (n=40)									
	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=2,196	White n=733	W-B diff	Black n=1,037	White n=236	W-B diff	Black n=2,312	White n=522	W-B diff
Race and frailty in model, no effect modification	43.0 (31.2-48.9)	48.9 (36.8-55.2)	5.9 (5.3-6.0)	14.0 (9.4-19.0)	11.6 (8.1-16.0)	-2.2	37.3 (28.2-47.2)	33.2 (25.9-43.6)	-3.2
Models with effect modification between frailty and race									
Borderline/Intact	39.2 (29.0-46.2)	49.3 (37.2-55.8)	8.7 (7.2-9.5)	13.6 (8.8-18.3)	11.5 (8.1-16.0)	-1.1	42.1 (32.5-52.0)	33.4 (25.7-43.2)	-7.1
Mild to Moderately Impaired	42.3 (31.8-49.4)	47.7 (37.0-55.0)	5.3 (4.8-5.4)	12.5 (8.3-17.2)	10.7 (7.4-14.9)	-1.5	39.5 (29.9-50.0)	35.4 (27.5-45.3)	-4.3
Moderately severe to very severely impaired	42.0 (30.7-48.7)	41.7 (37.1-53.5)	0.8 (0.2-1.1)	13.3 (8.8-18.2)	9.5 (6.4-13.6)	-3.9	39.3 (29.9-49.6)	42.0 (33.4-52.2)	2.5

Coverage and probabilities are **medians** for the facilities in that group and therefore do not add to 100%

Table 6-5a. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Cognitive Performance Scale (CPS): Michigan, 2005-2006

*Adjusted: Multilevel model included frailty scales (categorical variables): MDS CPS and covariates: sex, level of education, Medicaid, Private pay, Medicare, age, number of residents in the facility, proportion African-Americans in the facility, facility's affiliation with multi-facility chain, type of ownership, type of certification, compliance with program requirements for Medicare and/or Medicaid certification, number of nurse full-time equivalents, and proportions of residents on Medicaid, Medicare, and Private Pay

**W-B diff: median White-Black differences of facilities in each strata

& Adjusted probabilities are from a multilevel model with a multinomial outcome: vaccinated, refused, and 'not offered' (also include residents who were contraindicated for the vaccine (1-2%). There were no racial differences in proportions contraindicated.)

Table 6-5b. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Activities of Daily Living (ADL): Michigan, 2005-2006

0.1% to <5% Blacks in the nursing homes (n=118)									
Model	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=302	White n=16,859	W-B diff	Black n=106	White n=3,525	W-B diff	Black n=129	White n=5,125	W-B diff
Race and frailty in model, no effect modification	68.5 (63.0-71.1)	75.1 (69.9-77.4)	6.5 (6.1-6.7)	13.6 (12.4-14.8)	10.0 (8.8-10.9)	-3.8	16.5 (13.9-18.8)	14.0 (12.1-16.5)	-2.4
Models with effect modification between frailty and race									
1st quartile	71.5 (65.8-73.9)	75.1 (69.9-77.4)	3.6 (3.3-3.8)	10.7 (9.6-11.6)	10.0 (8.8-10.9)	-0.7	16.8 (14.3-19.0)	14.0 (12.1-16.2)	-2.7
2nd quartile	68.9 (62.9-71.4)	75.2 (70.0-77.4)	6.2 (6.0-6.8)	11.6 (10.5-12.8)	9.7 (8.5-10.5)	-2.1	18.3 (15.5-20.5)	14.3 (12.3-16.7)	-4.0
3rd quartile	66.7 (62.9-69.2)	75.5 (70.6-77.9)	8.0 (7.5-8.6)	21.3 (18.9-22.9)	10.2 (9.1-11.1)	-11.1	10.5 (8.8-12.3)	13.4 (11.5-15.4)	2.6
4th quartile	66.2 (60.1-69.0)	75.1 (70.2-77.3)	8.7 (8.3-9.3)	13.2 (12.1-14.4)	10.9 (9.6-11.8)	-2.4	19.1 (16.3-21.6)	13.2 (11.2-15.0)	-6.0
5% to <20% Blacks in the nursing homes (n=100)									
	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		

Table 6-5b. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Activities of Daily Living (ADL): Michigan, 2005-2006

	Black n=1,510	White n=13,459	W-B diff	Black n=520	White n=3,174	W-B diff	Black n=1,202	White n=7,307	W-B diff
Race and frailty in model, no effect modification	59.8 (53.7-65.0)	66.1 (60.0-70.8)	5.8 (5.5-6.1)	12.3 (10.5-13.2)	9.8 (8.5-10.7)	-2.3	25.7 (21.6-29.0)	22.4 (18.8-26.0)	-3.2
Models with effect modification between frailty and race									
1st quartile	61.4 (55.6-66.4)	66.1 (60.0-70.8)	4.2 (4.0-4.3)	12.3 (10.7-13.2)	9.8 (8.5-10.7)	-2.4	24.1 (20.2-27.3)	22.4 (18.8-26.0)	-1.7
2nd quartile	59.3 (52.9-64.4)	65.9 (60.0-70.7)	6.3 (6.0-6.7)	11.9 (10.1-12.9)	10.0 (8.7-10.9)	-1.6	26.8 (22.6-30.3)	22.2 (18.5-25.8)	-4.4
3rd quartile	61.3 (55.7-66.5)	68.2 (62.3-72.8)	6.2 (5.9-6.3)	12.8 (11.1-13.8)	9.0 (7.8-10.0)	-3.6	23.5 (19.7-26.7)	21.2 (17.7-24.9)	-2.4
4th quartile	60.1 (53.8-65.2)	66.6 (60.9-71.3)	6.2 (5.9-6.6)	11.8 (10.0-12.7)	10.0 (8.7-11.0)	-1.4	26.2 (22.0-29.6)	21.5 (18.0-25.0)	-4.4
20% to <50% Blacks in the nursing homes (n=33)									
	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=1,112	White n=2,738	W-B diff	Black n=396	White n=638	W-B diff	Black n=1,159	White n=2,096	W-B diff
Race and frailty in model, no effect modification	52.6 (42.0-61.4)	57.7 (47.8-66.7)	4.9 (4.2-5.0)	12.8 (10.1-14.6)	10.7 (8.3-12.2)	-1.8	26.2 (20.0-36.5)	23.0 (17.7-33.1)	-2.6

Table 6-5b. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Activities of Daily Living (ADL): Michigan, 2005-2006

Models with effect modification between frailty and race									
1st quartile	52.1 (40.9-61.0)	57.7 (48.1-67.1)	5.4 (4.8-5.6)	13.7 (10.8-15.5)	10.7 (8.3-12.2)	-2.5	26.1 (19.6-36.2)	23.0 (17.6-33.1)	-2.3
2nd quartile	51.7 (42.1-61.9)	60.4 (49.2-68.6)	7.1 (6.4-7.6)	11.7 (9.3-13.5)	11.1 (8.6-13.5)	-0.4	27.7 (21.3-38.5)	20.4 (15.5-29.8)	-6.9
3rd quartile	56.3 (44.5-64.7)	58.0 (48.0-67.1)	1.7 (1.4-1.9)	12.6 (9.9-14.3)	10.9 (8.5-12.5)	-1.8	23.0 (17.4-32.7)	22.6 (17.3-32.6)	-<0.1
4th quartile	53.5 (42.1-62.2)	57.6 (48.0-67.2)	4.0 (3.4-4.4)	13.4 (10.6-15.2)	10.4 (8.1-11.8)	-2.8	25.0 (18.9-34.9)	23.2 (17.8-33.5)	-1.0
≥ 50% Blacks in the nursing homes (n=40)									
	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=2,206	White n=736	W-B diff	Black n=1,040	White n=236	W-B diff	Black n=2,328	White n=524	W-B diff
Race and frailty in model, no effect modification	43.0 (31.3-48.5)	48.9 (37.1-54.9)	5.9 (5.4-6.0)	14.1 (9.2-18.9)	11.7 (7.9-16.1)	-2.3	37.4 (29.0-47.3)	33.3 (25.7-43.6)	-3.2
Models with effect modification between frailty and race									
1st quartile	36.5 (30.6-44.9)	49.3 (37.5-55.4)	9.3 (7.4-11.0)	11.0 (6.6-14.8)	11.4 (7.7-16.0)	0.9	46.3 (37.2-57.0)	33.3 (25.5-43.6)	-11.5

Table 6-5b. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Activities of Daily Living (ADL): Michigan, 2005-2006

2nd quartile	36.1 (28.0-43.6)	43.0 (33.2-50.4)	5.8 (5.1-6.6)	13.3 (8.1-17.8)	11.9 (7.6-16.6)	-0.6	45.3 (36.4-54.9)	38.9 (30.4-49.5)	-4.8
3rd quartile	36.7 (29.0-44.7)	38.9 (32.4-47.5)	2.5 (2.2-2.8)	12.6 (7.7-17.0)	10.7 (6.6-14.6)	-1.7	45.0 (36.1-55.0)	43.8 (34.8-54.9)	-0.6
4th quartile	36.8 (29.7-45.2)	40.7 (32.9-48.1)	2.1 (1.4-3.3)	12.1 (7.3-16.3)	6.2 (3.7-8.5)	-5.9	45.2 (36.3-55.5)	48.1 (38.7-58.9)	2.7

Coverage and probabilities are **medians** for the facilities in that group and therefore do not add to 100%

*Adjusted: Multilevel model included frailty scales (categorical variables): MDS ADL Long Form Scale and covariates: sex, level of education, Medicaid, Private pay, Medicare, age, number of residents in the facility, proportion African-Americans in the facility, facility's affiliation with multi-facility chain, type of ownership, type of certification, compliance with program requirements for Medicare and/or Medicaid certification, number of nurse full-time equivalents, and proportions of residents on Medicaid, Medicare, and Private Pay

**W-B diff: median White-Black differences of facilities in each strata

& Adjusted probabilities are from a multilevel model with a multinomial outcome: vaccinated, refused, and 'not offered' (also include residents who were contraindicated for the vaccine (1-2%). There were no racial differences in proportions contraindicated.)

Table 6-5c. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Changes in Health, End-stage disease and Symptoms and Signs (CHESS): Michigan, 2005-2006

0.1% to <5% Blacks in the nursing homes (n=118)									
Model	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=322	White n=17,854	W-B diff	Black n=112	White n=3,709	W-B diff	Black n=138	White n=5,426	W-B diff
Race and frailty in model, no effect modification	68.5 (63.0-71.0)	75.1 (69.9-77.4)	6.5 (6.1-6.7)	13.6 (12.4-14.9)	10.0 (8.8,10.9)	-3.8	16.5 (14.0-18.7)	14.0 (12.1-16.3)	-2.4
Models with effect modification between frailty and race									
Borderline/Intact	70.7 (65.5-72.5)	75.1 (69.8-77.4)	4.1 (3.9-4.4)	14.9 (13.2-16.2)	10.0 (8.8-10.9)	-4.9	13.1 (11.1-15.1)	14.0 (12.1-16.2)	0.7
Highly frail	65.8 (59.3-68.2)	75.3 (70.1-77.6)	9.4 (8.9-10.0)	12.0 (11.0-12.9)	10.0 (8.8-10.8)	-2.0	21.1 (17.9-23.5)	13.8 (11.9-16.0)	-7.2
5% to <20% Blacks in the nursing homes (n=100)									
	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=1,607	White n=14,225	W-B diff	Black n=555	White n=3,370	W-B diff	Black n=1,285	White n=7,766	W-B diff
Race and frailty in model, no effect modification	59.9 (53.8-65.0)	66.1 (60.0-70.8)	5.8 (5.5-6.0)	12.3 (10.5-13.2)	9.8 (8.5-10.7)	-2.3	25.7 (21.6-29.9)	22.4 (18.8-26.0)	-3.2

Table 6-5c. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Changes in Health, End-stage disease and Symptoms and Signs (CHESS): Michigan, 2005-2006

Models with effect modification between frailty and race									
Borderline/Intact	60.7 (54.6-65.8)	66.1 (60.0-70.8)	5.0 (4.7-5.3)	11.9 (10.2-12.7)	9.8 (8.6-10.7)	-1.9	25.3 (21.3-28.6)	22.4 (18.8-26.0)	-2.8
Highly frail	57.4 (51.4-62.7)	65.0 (59.0-69.7)	7.0 (6.8-7.2)	13.5 (11.5-14.6)	10.4 (9.1-11.3)	-2.9	26.4 (22.4-30.2)	22.8 (19.0-26.4)	-3.7
20% to <50% Blacks in the nursing homes (n=33)									
	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=1,171	White n=2,903	W-B diff	Black n=424	White n=671	W-B diff	Black n=1,220	White n=2,227	W-B diff
Race and frailty in model, no effect modification	52.6 (42.0-61.3)	57.7 (47.8-66.7)	4.9 (4.3-5.1)	12.8 (10.1-14.6)	10.7 (8.3-12.2)	-1.8	26.2 (20.1-36.5)	23.0 (17.7-33.1)	-2.6
Models with effect modification between frailty and race									
Borderline/Intact	53.0 (43.3-62.7)	57.7 (47.8-66.8)	4.1 (3.9-4.4)	11.8 (9.3-13.5)	10.7 (8.3-12.2)	-0.9	26.4 (20.3-37.0)	23.0 (17.7-33.1)	-3.0
Highly frail	52.4 (41.4-61.0)	58.9 (48.5-68.3)	5.6 (4.9-5.8)	13.2 (10.4-15.0)	9.7 (7.5-11.1)	-3.0	26.1 (19.9-36.3)	23.2 (18.1-33.5)	-1.9
> 50% Blacks in the nursing homes (n=40)									

Table 6-5c. Within facility vaccination coverage by % Black residents in the facility, effect measure modification of race with frailty defined by Changes in Health, End-stage disease and Symptoms and Signs (CHESS): Michigan, 2005-2006

	Vaccination Coverage*								
	Vaccinated&			Refused			Not offered**		
	Black n=2,329	White n=781	W-B diff	Black n=1,089	White n=254	W-B diff	Black n=2,478	White n=545	W-B diff
Race and frailty in model, no effect modification	43.0 (31.2-48.9)	49.0 (36.9-55.3)	5.9 (5.4-6.1)	13.9 (9.4-19.0)	11.6 (8.1-16.0)	-2.2	37.3 (28.2-47.2)	33.1 (25.8-43.6)	-3.2
Models with effect modification between frailty and race									
Borderline/Intact	42.0 (30.7-48.3)	48.9 (37.0-55.3)	6.7 (5.8-6.9)	13.6 (9.0-18.4)	11.6 (8.1-16.0)	-1.7	38.6 (29.1-48.5)	33.2 (26.0-43.7)	-4.5
Highly frail	43.9 (32.4-50.3)	48.2 (38.2-55.6)	4.6 (4.4-5.1)	12.9 (8.7-17.7)	10.2 (7.0-14.1)	-2.7	37.1 (27.7-47.5)	34.6 (27.3-45.1)	-1.6

Coverage and probabilities are **medians** for the facilities in that group and therefore do not add to 100%

*Adjusted: Multilevel model included frailty scales (categorical variables): MDS-CHESS and covariates: sex, level of education, Medicaid, Private pay, Medicare, age, number of residents in the facility, proportion African-Americans in the facility, facility's affiliation with multi-facility chain, type of ownership, type of certification, compliance with program requirements for Medicare and/or Medicaid certification, number of nurse full-time equivalents, and proportions of residents on Medicaid, Medicare, and Private Pay

**W-B diff: median White-Black differences of facilities in each strata

& Adjusted probabilities are from a multilevel model with a multinomial outcome: vaccinated, refused, and 'not offered' (also include residents who were contraindicated for the vaccine (1-2%). There were no racial differences in proportions contraindicated.)

CHAPTER 7 WHAT FACTORS CONTRIBUTE TO THE RACIAL GAP IN VACCINE OFFERING AMONG NURSING FACILITIES IN MICHIGAN, 2005-2006?

Background: The difference between Michigan White and Black nursing home residents' receipt of the influenza vaccine for the 2005-2006 influenza season exceeded 20 percentage points. Although racial inequities existed both within and between facilities, differences *between* facilities, facilities stratified by the proportion of Black residents, account for the majority of the state-wide inequity.

Objectives: To identify facility and/or county characteristics in addition to facility racial composition associated with the large differences in offering the influenza vaccine between nursing homes.

Methods: We examined data from the Minimum Data Set (MDS) for all residents in Michigan from October 1, 2005 through March 31, 2006. Facility-level data from the Online Survey Certification and Reporting (OSCAR) database were merged with the MDS data. Analyses included factor analysis and multilevel models, overall for all nursing homes, and nursing homes stratified by proportion of Black residents (i.e., 0%, 0.1%-4.9%, 5%-19.9%, 20%-49.9%, and $\geq$ 50%) which assessed facility and county level factors associated with offering the vaccine among nursing home residents.

Results: Administrative factors, case mix indicators, staff resources, and county level resources together accounted for 36.9% of the variability in influenza vaccine offering among the 403 nursing homes in Michigan. The percent of variability

accounted for by facility and county characteristics varied among the 5 strata of nursing homes, from 20.1% among the homes with 0.1%-5% Blacks to 54.8% among the homes with 20%-49.9% Blacks. No factor consistently contributed to variability between nursing homes in offering vaccine among the 5 strata of homes. No underlying latent constructs were identified and confirmed. Among all White nursing homes, 90.3% of residents were offered the vaccine compared to 63.7% of Blacks in homes with $\geq$ 50% Black residents. This difference decreased by 20.3 percentage points after adjusting for facility characteristics that contributed to the offering differences.

Conclusion: Characteristics that contributed to the variability in offering vaccine between homes are multifactorial but include higher levels of staff resources, higher levels of patients with speech problems and on psychotropic drugs, and lower proportions of Blacks in the facility and county. These individual factors were not driven by the latent constructs we hypothesized and tested; therefore the remaining variability in vaccine offering may be due to unmeasured factors such as type of facility immunization program and staff attitudes towards vaccination.

INTRODUCTION

As of the beginning of 2005, Michigan state law (M.C.L.S. § 333.21716) asserted that a nursing home should provide each resident with information and assistance in obtaining an annual vaccination against influenza.[121] However, our previous analyses indicate only 60.4% of all residents of nursing homes who had assessments conducted in the state from October 1, 2005 through March 31, 2006 received the vaccine.[122] Also, a White-Black difference of 20.5 percentage points in receipt of the influenza vaccine was identified among nursing home residents in Michigan (the state with the highest such disparity); racial inequities exist both within and between facilities. Differences between facilities accounted for the majority of the state-wide inequity. Another study primarily found racial disparities in quality of care between facilities, rather than within facilities.[123]

Facilities in which the majority of residents were Black had the highest median proportion not offered and the lowest proportion not receiving the vaccine. Those facilities account for only 41 out of 403 (10.2%) facilities in Michigan, yet they house 47% of Black residents in the state. The remaining unexplained variability in not being offered the vaccine between nursing homes stratified by the proportion of Black residents (in the multilevel models) implicated several facility-level factors contributing to the inequity in vaccination between nursing facilities that vary by the proportion of Black residents included resources, staff practices of vaccination and policies. These factors appear to contribute to the differing vaccine offering levels after adjusting for resident and facility covariates, resident refusals, and correlation from the clustered structure of residents within nursing facilities.

The history of segregation in access to nursing could play a role in why vaccination levels vary considerably by the proportion of Black residents in the nursing home. Other studies have found that nursing homes with greater proportions of Black residents had higher levels of other poor quality indicators.[6,124] One study published in 2005 found that the funding mix of nursing home residents has created a two-tier system (i.e., 'haves' and 'have nots') and that Black residents tend to be concentrated in the lower tier.[6] Smith considers this finding an artifact from a legacy of nursing homes constituting a segregated two-class system of care.[78] From the 1940's through the 1960's federal funding was available for hospital facilities and segregation was acceptable in "cases where separate hospital facilities are provided for separate population groups, if the plan makes equitable provision on the basis of need for facilities and services of like quality for each such group." (U.S. Civil Rights Commission 1963, 130). In other words, this "separate but equal provision" allowed for segregation in both hospitals and nursing homes. Although the law made separation legal, it did not enforce equality.

To comply with Medicare legislation in the 1960's, particularly Title VI, hospitals had to integrate quickly due to the threatened loss of federal funds. In contrast, the majority of funding of nursing home care came through state Medicaid programs, sparing nursing homes from the rapid federal compliance reviews required for hospitals. Nursing homes, as "people's homes and not just places where they received brief medical treatment," did not experience a similar pressure to integrate[78] Enforcement of Medicare and Medicaid legislation of the 1960's did close many hospitals for life-safety violations, and many of the closed Black hospitals were converted to nursing homes and continued to provide care to a predominantly Black clientele.[78]

The racial composition of nursing homes today still reflects the history of nursing home segregation and quality of care still remains largely unequal. Clearly, the racial composition of nursing homes does not 'cause' quality of care, but provides a surrogate indicator of complex interrelated factors that do affect the quality of care. One would expect standing orders and clinical practice guidelines to overcome much of the observed differences in care, such as offering and receiving influenza vaccine. That differences resulting in differential vaccine uptake persist provides a context to better understand important and modifiable drivers for reduced racial composition linked adherence to care standards. For this study we sought to identify modifiable factors associated with the differences in offering the influenza vaccine between nursing homes with different facility racial compositions. Because of the multilevel nature of the research question that considers race and vaccination at the individual and facility levels, our approach involves methods that allow adjusted estimation at both levels simultaneously. [13]

METHODS AND MATERIALS

Study population

During the 2005-2006 influenza season, there were 426 Medicare- and Medicaid-certified nursing facilities in Michigan, 18 of which were owned or operated by hospitals. These hospital-administered facilities provide post-acute care serving mainly Medicare-eligible residents. Since our study focuses on the traditional nursing home population, we excluded hospital-based facilities and residents from the analyses. The analyses in this paper included residents from the 403 (98.8%) of the 408 nursing homes that had complete facility-level data.

Nursing home staff administers resident assessments at admission, quarterly, and for any significant change in condition for all residents in Medicare/Medicaid certified facilities. From October 1, 2005 through March 31, 2006, 241,485 resident assessment instruments (RAI) were completed in Michigan, submitted to the Centers for Medicare & Medicaid Services (CMS), and included in the Minimum Data Set (MDS). To identify a unique assessment for residents with multiple assessments, we used probabilistic software, LinkPlus,[113] thereby including each resident once in each facility. The number of residents with assessments included a total of 92,425 White and Black residents; of these, 90,120 had complete information and represented 83,534 unique residents (6,586 lived in >1 home).

Resident-level Data

Descriptive variables from the RAI include level of education, gender, age, type of insurance, and race. The CMS training manual for the MDS guides the determination of race to occur by self-assessment or the race 'within which the resident places self.'[114] The RAI has one variable for race/ethnicity that allows for one of the following responses: 1) American Indian/Alaskan native, 2) Asian/Pacific Islander, 3) Black, not of Hispanic origin, 4) Hispanic, and 5) White, not of Hispanic origin. We excluded residents reported as other than 'White' or 'Black' from the analysis; these residents comprised <2% of the nursing home residents in Michigan. We adjusted for resident level variables associated with race and receipt of vaccine including gender and age.

Vaccination Status

The question on the immunization supplement to the assessment instrument asks, "Did the resident receive the influenza vaccine in this facility for this year's influenza

season (October 1 through March 31)?" The next question asks, "If influenza vaccine was not received, state reason: 1) not in facility during this year's flu season; 2) received outside of this facility; 3) not eligible; 4) offered and declined; 5) not offered [other] (i.e., no other specific reason for not offering the vaccine); and 6) inability to obtain vaccine." Because the majority of residents underwent multiple assessments, we used an algorithm to determine the reasons for remaining unvaccinated.[46] We categorized residents as receiving an offer for vaccine if they were reported to have received the vaccine in or outside of the facility, if they were offered and refused the vaccine, and if vaccine was indicated as "contraindicated." We based the latter determination on the knowledge of contraindication likely only following an initial vaccine offering or intent to offer. Residents were categorized as not offered the vaccine if they had assessment dates during the influenza season but were reported to not be in facility during this year's flu season, were not offered [other], or the facility was unable to obtain vaccine, and therefore did not receive the vaccine. There was no racial difference in the proportion of residents who resided in >1 nursing facility during the influenza vaccination season (approximately 8%) (the vaccination status reported by each facility was included exactly as that facility reported it.)

Facility-level Data

We obtained the data from the Online Survey and Certification Assessment Reporting System (OSCAR) submitted during the influenza season from CMS. The OSCAR, a federal administrative database, contains structural, staffing and other information on nursing facilities. It includes data for all U.S. nursing homes that Medicare and/or Medicaid certifies. State survey and certification agencies collect the

data, which are part of the annual nursing home certification and recertification process. Each facility completes a standardized form annually about the facility characteristics, e.g., number of beds, affiliation, and staffing levels. State surveyors review the form and enter the data into the OSCAR database. State surveyors also visit each facility and decide whether the facility is deficient in meeting standards in the following areas: administration, quality of care, resident rights, mistreatment, environment, pharmacy services, residents' assessments, and nutrition/dietary. Surveyors report deficiencies as being isolated, a pattern, or widespread and the deficiencies are reported by severity and level of harm to the OSCAR. We merged the OSCAR data with the residents' MDS data by facility.

Racial Composition of the Facility

To assess racial differences in vaccination within and between nursing homes, we grouped facilities by percent of Black residents: 0%, >0% to <5%, 5% to <20%, 20% to <50%, and ≥ 50%. We chose these categories to examine homes with no Black residents (i.e., 0% Black residents), homes in which Blacks were in the majority (i.e., ≥ 50%) and groups in between with substantial proportions of Black residents (i.e., <5%, 5%- <20% and 20%- <50%) and that had sufficient sample sizes. These cutoffs were chosen for conceptual reasons rather than using data driven cutoff points such as quartiles. Further, these cutoffs can be used in any analysis because they are not population-specific (like quartiles).

County Level Data

County level characteristics such as the number of beds per capita[78] and poverty[125] have been found in previous studies to be associated with facility racial composition and quality indicator outcomes. Data from the Area Resource File (2007 ARF) were used to examine county level poverty by individuals and families (i.e., > 10% above poverty level in the county, 2000 census). The number of beds in the facilities was obtained from the OSCAR and summed by county. Other variables used from the ARF included the total county population (to determine the county beds to population ratio) and the proportion of persons aged 25 years and old by education (i.e., < high school, high school graduate, 4+ years of college).

Statistical Analysis

Factor analysis: Multilevel

Factor analysis was used to identify latent factors based on facility and resident variables. Facility constructs of six groups of facility level exposure variables were assessed: 1) administrative or descriptive (e.g., type of ownership, affiliation with a chain); 2) case-mix indicators (i.e., proportion of residents in the facility by severity of illness defined by various indicators); 3) staff resources (e.g., number of nurse full-time equivalents); 4) state surveyor reported deficiencies; 5) county-level characteristics (e.g., number nursing home beds, proportion Blacks); and 6) funding mix (i.e., Medicare, Medicaid, and Private payment). Constructs examined using factor analysis also included these resident level variables: quality of life, presence of diabetes, history of accidents and falls in the past six months, speech problems, and type of insurance. See appendix A and conceptual model [Figure 1]. MPlus software was used (Muthen and Muthen, Los Angeles, Ca, 2010).

Although one model identified using exploratory factor analysis was a good fit, this model could not be confirmed. Therefore it was not appropriate to run a structural equation model.

Logistic (one-level) regression

We used logistic regression to examine bivariate patterns of facility level characteristics from the six groups mentioned previously with two outcomes 1) the proportion of residents offered the influenza vaccine in the nursing home (model stratified by racial composition of the homes) and 2) the proportion of Black residents in the nursing home.

Multilevel regression

Logistic multilevel models using HLM v.6.06 (Scientific Software International, Inc., Lincolnwood, Il, 2008) software were used to assess how much of the between facility variability in not being offered the influenza vaccine was attributable to the facility variables from the following domains: administrative factors, case mix indicators, staff resources, facility deficiencies, county level resources, and the two-tiered system of residents' funding. All variables in the final multilevel models were assessed for joint collinearity using Condition Indices,[126] which indicated collinearity was not sufficient to obscure the estimates (condition index for the first variance decomposition proportion for each model was < 30). Because the research question was to examine the facility level factors associated with *between* facility differences in offering vaccine, few resident level covariates were included (e.g., age and sex). Five models, stratified according to the proportion of Black residents in the facility, were assessed separately. Analyses were stratified in this way because Black nursing home residents are not exchangeable with

White nursing home residents according to the counterfactual assumption that a person who is 'exposed' (i.e., Black) would be the same person if 'unexposed' (i.e., White), except for the fact of exposure.[115] Estimates from the models were also used to calculate the adjusted probability of being offered the vaccine by race for each nursing home.

RESULTS

Descriptive statistics

Among the 403 nursing homes, the median proportions of residents by facility characteristics varied by the proportion of Black residents in the homes [Table 1]. The median number of beds was 113, the median proportions of residents were: 27% with diabetes, 36% with falls or accidents in the past 180 days, 12% with very poor quality of life, 7% with renal problems, and 42% with psychiatric problems. Homes with $\geq$ 50% Blacks had a higher proportion of homes not in compliance with CMS program requirements (12.5%) than homes with < 50% Blacks (range: 2.7% - 6.0) [Table 2].

Multilevel regression

The variance components of the random effects in the multilevel models allow interpretation for the percent of variability between nursing homes in the proportion of residents offered the influenza vaccine. The percent of variability accounted for by facility and county characteristics varied across the five strata of nursing homes from 20.1% among the homes with >0% to <5% Blacks to 54.8% among the homes with 20% to <50% Blacks [Table 3]. No single factor consistently contributed to variability between nursing homes in offering vaccine across the five strata of homes. Regression coefficients from the multilevel models are presented to indicate the direction of the

relationship between the facility level variables examined with offering of vaccine [Table 4].

The ratio of FTEs to residents contributed the most to variability in offering vaccine among the four strata of homes with <50% Blacks (range: 13.8% -26.3%). Case mix indicators explained <3.5% of the variability in offering vaccine in three of the strata but between 14.9-16.9% in the 2 extreme racially mixed strata of homes (i.e., >0% to <5% and ≥ 50% Blacks). However, there was no consistency in which of the case-mix variables contributed to the variability, nor in the direction of contribution.

Administrative factors contributed a small proportion of variability in offering vaccine among the strata of homes with <20% Blacks (<4%), whereas among homes in the two strata with ≥ 20% Blacks a substantial amount of variability in offering vaccine was contributed by administrative factors (>24%). In fact, among the 41 homes with ≥ 50% Blacks, most of the variability in offering vaccine was related to administrative characteristics, including compliance with CMS requirements for certification (30.3%).

Among the 33 nursing homes with 20% to <50% Blacks, the number of deficiencies contributed to a small amount of variability that was positively associated with offering vaccine (4.2%). In addition, county resources and the two-tiered system of resources contributed to the variability in offering vaccine in this stratum of homes.

DISCUSSION

Factors contributing to the variability in offering vaccine between homes varied among homes stratified by the proportion of Black residents in the home. Administrative characteristics contributed the most in homes with ≥ 20% Blacks whereas staff resources measured by the ratio of FTEs to residents contributed a large proportion among homes

with ≤ 50% Blacks. Based on the variables we measured in this population, we could not confirm latent constructs that contribute to the variability in offering vaccine between homes. Rather, the differences in offering vaccine in Michigan may be due to unmeasured factors such as the type of immunization program adopted by the facility,[88] staff attitudes towards vaccination.[127] In addition, a greater proportion of minority staff may provide a surrogate marker of cultural attitudes that result in lower levels of offering or administering vaccine.[119]

Administrative factors contributed less than 4% of the variability in offering vaccine between nursing homes overall and in homes with < 20% Blacks, but among homes with ≥ 20% Black residents administrative factors contributed over 24% of the variability in offering vaccine. Affiliation with a chain was negatively associated with offering vaccine overall among homes with 0% Blacks as well as homes with ≥ 50% Blacks. A national study during the same season found that residents of homes affiliated with a chain had lower levels of offering vaccine than residents of independent homes (80.6% vs 86.2%),[46] despite having centralized management which should lead to economies of scale. Overall and in the two strata of homes in which certification explained the variability in offering vaccine, SNF-Medicare certification was associated with lower offering levels whereas Medicaid certified-only and dual certification were associated with higher offering levels. The national study also found that residents of Medicaid-only certified homes had much higher levels of being offered the vaccine (92.6%) than residents of dually-certified (Medicare and Medicaid) homes (83.9%), residents of distinct-part homes (80.3%) and residents of Medicare-only certified homes (74.1%). This finding may be due to residents in Medicaid-only certified homes having a

longer length of stay which is also associated with higher likelihood of receiving the vaccine.[118] Longer length of stay is associated with greater likelihood of vaccination for several reasons: 1) likelihood of residents' presence in the facility when a systematic program offering vaccine is conducted; 2) likelihood of residents' presence in the facility when vaccine quality assurance reviews are conducted or a second offering of vaccine occurs; and 3) overall increased exposure to staff who can vaccinate, or to encounter staff or a family member who advocates vaccination. Also, residents in Medicare-only certified homes tend to have a short length of stay as Medicare only pays for post-recuperative stays up to 100 days.

Compliance with program requirements for CMS' certification was a strong positive contributor to vaccine offering variability among the homes with the majority Blacks (i.e, ≥50%). Although only 5% of the nursing homes in Michigan were not in compliance with CMS requirements, more than twice as many of those non-compliant homes were among the homes with ≥ 50% Black residents compared with the homes with < 50% Blacks, suggesting those facilities likely have critical issues to address that may take priority over preventive services such as vaccination.

Case mix indicators contributed to variability in offering vaccine between nursing homes the most in the 2 racially mixed extreme strata of homes (i.e., with the fewest Blacks (>0% to <5%) and the most Blacks (≥ 50%). Characteristics with a positive association included proportions of residents with speech problems, on psychotropic drugs, and psychiatric problems. Homes with higher proportions of residents on psychotropic drugs could be associated with higher offering levels of vaccine because those problems are associated with being younger, healthier, less frail residents who are

more likely to get vaccinated. A recent study found that antipsychotic drug use is associated with higher risk of pneumonia in the elderly.[128] This may provide incentive to make sure residents indicated for such drugs are offered the influenza vaccine, as it has been shown to prevent some comorbidities such as pneumonia.[66]

Higher proportions of residents with renal problems were associated with lower offering levels between homes in 2 of the strata of homes. Those residents tend to be clustered in homes that may accommodate their differing needs. Because renal disease is an indication for getting the influenza vaccine, in addition to living in a nursing home and being > 65 years of age,[66] we did not expect to find that the proportion of residents with renal problems would inversely associate with having influenza vaccine offered.

Staff resources that contributed to the variability in offering the vaccine between nursing homes included the ratio of FTEs to the number of residents with assessments conducted between Oct 1, 2005 and March 31, 2006. This variable was positively significantly associated with higher levels of offering vaccine in the 4 strata of homes with $\leq$ 50% Black residents. The finding of the ratio of FTEs to residents contributing the most to variability in offering vaccine between *all* facilities suggests those facilities with the most staff measured by FTEs and the lowest turnover of residents are most able to offer the vaccine. This represents the kind of home that may have the highest level of staff resources to be able to give the vaccine. In addition, the lower resident turnover may also reflect the staff that have the closest relationships with the residents; in other words, they know the residents and their individual needs the best because the resident population is somewhat stable during the influenza season.

County characteristics contributed to the variability in offering the vaccine between nursing homes in 2 of the strata of homes. One county characteristic was the proportion of families below poverty in the county (negative association) among homes with >0 to <5% Blacks. Counties with the most families living below poverty likely have fewer resources overall and it follows that influenza vaccine could therefore be less available to any of its residents whether community-dwelling or institutionalized. Another county characteristic that contributed to the difference in offering vaccine between homes was the number of nursing home beds per county population (positive association) among homes with 20% to <50% Blacks. In a review by the Institute of Medicine, nursing-home beds were found to be in shorter supply in states with higher proportions of Blacks in the population.[76] In some states, the ratio of nursing home beds to population in the county was much higher in counties with higher proportions of whites. The effect of this pattern of racial discrimination in geographic access to nursing homes resulted in a large proportion of Medicaid dollars spent for nursing home care, intended to provide access to the poor without regard to race.[78] In our analyses in the same strata of homes with 20% to <50% Blacks, the two-tiered system of funding contributed to the variability in offering vaccine. In particular, higher proportions of residents on Medicaid were associated with higher offering levels of vaccine which explained some of the variability in offering among the 33 nursing homes. This suggests that perhaps the measures taken to provide access to the poor may also be associated with better quality of care in terms of offering the influenza vaccine.

Prior research has found that compared with Whites, Blacks are disproportionately admitted to nursing homes with significantly greater government-

assigned deficiency citations.[96] The number of deficiencies, whether isolated, a pattern, or widespread, of any type or severity, contributed to a small amount of variability that was positively associated with offering vaccine (4.2%) among the 33 nursing homes with 20% to <50% Blacks. This finding is contrary to what we found in the homes with ≥ 50% Black residents pertaining to non-compliance. Therefore this group of homes may differ in that the attention garnered by deficiencies may prompt nursing home staff to be more solicitous of other services known to be criteria for certification. It may also mean that facility immunization policy and staff attitudes toward vaccination may play more important roles in terms of vaccine offering, regardless of the overall quality of care in the home.

Limitations

There are several limitations to these data. Approximately 7% of residents were reported to be unvaccinated because they were not in the facility during the influenza season (between October 1 and March 31), yet their assessment dates (and types) indicate that they did live in the facility during that time. There was no racial difference in this misclassification (data not presented). Also, vaccination status reported in the MDS has not been validated. Another limitation may be that we analyzed only one state and therefore the data may not be generalizable to what drives racial variability in vaccine uptake in other states. We have done preliminary analyses individually examining 10 other states with ≥ 9.6 percentage point racial gaps in vaccination during the same season and found similar trends in inequities in offering vaccine *between* facilities, stratified by proportion of Black residents.

Conclusions

Our analyses could account for only 20.1% to 54.8% of the variability in offering influenza vaccine between nursing homes stratified by the proportion of Black residents in Michigan. The remaining unexplained variability suggests that additional facility level factors should be examined that may contribute to the inter-facility differences in offering vaccine. For example, immunization programs or policies, resources, and staff attitudes towards vaccination may influence the offering of vaccine to residents. One study found that in nursing homes with standing orders for influenza vaccination the racial gap in vaccination was negligible.[129] Intervention studies are needed to determine the impact of implementation of policies such as standing orders on narrowing disparities and increasing vaccination rates. Effective interventions would reduce inequities in vaccination coverage and reduce morbidity and mortality due to vaccine-preventable illness as well as avoid costs by reducing acute hospitalizations.[17] Indeed, the broadening of the influenza vaccine recommendation to universal may be an important step toward reducing inequities, particularly if the vaccine is offered independent of the ability to pay.

Table 7-1. Nursing home characteristics
Michigan, 2005-2006 influenza season

	All	Facilities grouped by % Black residents				
	N=403	n=111 0% Blacks	n=118 0-<5% Blacks	n=100 5-<20% Blacks	n=33 20-<50% Blacks	n=41 >=50% Blacks
	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*
% residents offered influenza vaccine	84% (58%, 95%)	90% (77%, 97%)	86% (64%, 95%)	79% (58%, 91%)	77% (42%, 90%)	65% (30%, 96%)
Administrative characteristics						
Number of beds	113 (51, 180)	95 (43, 152)	116 (53, 187)	121 (61, 201)	123 (80, 180)	122 (79, 176)
Total number of residents during influenza season	197.0 (84, 402)	159 (68, 265)	217 (95, 425)	238 (112, 582)	222 (114, 602)	169 (87, 311)
Number of state surveyor reported deficiencies in past year	4 (3, 17)	4 (3, 16)	4 (2, 16)	4 (3, 15)	4 (3, 17)	4 (3, 26)
Turnover: total residents/total beds during influenza season	1.73 (1.26, 3.21)	1.67 (1.27, 2.27)	1.82 (1.31, 3.39)	1.82 (1.37, 4.27)	1.65 (1.15, 4.42)	1.42 (1.07, 2.38)
Case-Mix Characteristics						
facility % with diabetes	27% (18%, 34%)	24% (15%, 30%)	26% (18%, 32%)	28% (21%, 36%)	31% (22%, 36%)	27% (18%, 36%)
facility % with falls in past 180 days	36% (22%, 45%)	38% (28%, 46%)	39% (27%, 47%)	38% (29%, 45%)	33% (19%, 41%)	19% (9%, 32%)
facility % with poor quality of life	12% (3%, 32%)	12% (5%, 33%)	13% (3%, 40%)	11% (3%, 26%)	11% (3%, 30%)	14% (4%, 30%)
facility % with renal problems	7% (3%, 13%)	7% (2%, 12%)	6% (3%, 11%)	8% (3%, 14%)	9% (5%, 12%)	10% (6%, 17%)
Facility % with speech problems	26% (13%, 41%)	26% (12%, 40%)	24% (13%, 38%)	27% (11%, 44%)	27% (15%, 40%)	31% (14%, 42%)
Facility % on psychotropic drugs	34% (24%, 44%)	31% (21%, 40%)	34% (24%, 44%)	35% (28%, 46%)	34% (26%, 49%)	34% (25%, 49%)
Facility % with psychiatric problems	42% (28%, 52%)	41% (31%, 53%)	45% (33%, 54%)	43% (32%, 53%)	39% (28%, 50%)	27% (13%, 41%)
Average Resource Utilization Group (RUG) and Case-Mix Index (CMI)**	.83 (.76, .92)	.81 (,75, .90)	.82 (.77, .90)	.85 (.78, .97)	.85 (.77, .98)	.82 (.76, .90)
Average Activity of Daily Living (ADL) scale	16.9 (16.1, 17.5)	16.9 (16.0, 17.8)	16.8 (16.1, 17.5)	16.9 (16.2, 17.4)	16.8 (16.0, 17.4)	16.8 (16.2, 17.5)

Table 7-1. Nursing home characteristics
Michigan, 2005-2006 influenza season

	All	Facilities grouped by % Black residents				
	N=403	n=111 0% Blacks	n=118 0-<5% Blacks	n=100 5-<20% Blacks	n=33 20-<50% Blacks	n=41 >=50% Blacks
	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*
Facility % with low CPS (0-2)	47% (42%, 52%)	48% (41%, 53%)	47% (42%, 53%)	47% (42%, 52%)	46% (43%, 53%)	46% (41%, 52%)
Facility % with mid CPS (3-4)	34% (29%, 39%)	34% (29%, 40%)	34% (28%, 39%)	34% (30%, 37%)	34% (29%, 38%)	34% (29%, 39%)
Facility % with high CPS (5-6)	12% (9%, 16%)	12% (9%, 16%)	12% (9%, 16%)	12% (9%, 16%)	12% (9%, 16%)	13% (9%, 16%)
Facility % with incontinent bowel**	45% (29%, 64%)	38% (24%, 49%)	43% (30%, 57%)	48% (35%, 64%)	57% (36%, 68%)	63% (49%, 71%)
Facility % with incontinent bladder**	60% (46%, 73%)	58% (44%, 71%)	61% (47%, 73%)	61% (48%, 73%)	59% (47%, 68%)	64% (48%, 79%)
Residents' average number of prescriptions in Facility**	10.1 (8.5, 11.8)	10.3 (8.6, 11.8)	10.3 (8.9, 11.7)	10.3 (8.9, 12.1)	9.6 (8.4, 11.8)	8.9 (7.5, 9.9)
% residents dependent on drugs in the facility**	51% (34%, 64%)	52% (41%, 65%)	54% (40%, 65%)	51% (40%, 63%)	43% (34%, 61%)	31% (20%, 50%)
Acuity Index**	11.1 (9.6, 12.5)	10.8 (9.4, 12.0)	11.1 (9.8, 12.4)	11.3 (10.0, 12.6)	11.4 (9.7, 12.9)	11.1 (9.4, 13.2)
Staff characteristics						
Total number of RN FTEs	65.0 (29.7, 125.3)	57.8 (26.0, 118.0)	68.9 (29.7, 129.4)	65.8 (36.8, 131.2)	65.1 (43.9, 135.2)	63.1 (32.2, 104.2)
Ratio of FTEs to residents	.35 (.20, .55)	.41 (.26, .59)	.33 (.21, .48)	.31 (.16, .47)	.35 (.14, .53)	.39 (.19, .48)
Ratio of FTEs to beds	.62 (.45, .82)	.69 (.54, .90)	.62 (.47, .82)	.59 (.45, .78)	.60 (.47, .70)	.55 (.37, .69)
RN hours per resident day*	.28 (.12, .57)	.32 (.16, .62)	.29 (.13, .58)	.27 (.12, .55)	.28 (.15, .45)	.17 (.09, .52)
LPN hours per resident day*	.67 (.39, 1.0)	.61 (.31, .88)	.67 (.42, 1.0)	.69 (.43, 1.1)	.74 (.47, .93)	.70 (.38, 1.1)
CNA hours per resident day*	2.3 (1.8, 2.9)	2.5 (1.9, 3.3)	2.2 (1.8, 2.9)	2.2 (1.7, 2.8)	2.2 (1.7, 2.7)	2.2 (1.5, 2.6)
Direct-care staff hours per resident day**	3.2 (2.7, 4.2)	3.4 (2.6, 4.3)	3.2 (2.7, 4.2)	3.2 (2.7, 4.1)	3.2 (2.5, 4.0)	3.0 (2.4, 4.0)
% RN FTES of total RN + LPN FTEs**	29% (14%, 54%)	34% (17%, 63%)	29% (15%, 54%)	26% (14%, 49%)	30% (17%, 42%)	19% (8%, 47%)

Table 7-1. Nursing home characteristics
Michigan, 2005-2006 influenza season

	All	Facilities grouped by % Black residents				
	N=403	n=111 0% Blacks	n=118 0-<5% Blacks	n=100 5-<20% Blacks	n=33 20-<50% Blacks	n=41 >=50% Blacks
	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*	Median (10^{th}, 90^{th})*
County Characteristics						
% individuals in poverty in the county	11.1% (5.5%,16.4%)	10.2% (5.5%,14.4%)	9.0% 5.5%,16.4%)	11.4% (5.5%,16.4%)	13.1% (5.5%,16.4%)	16.4% (5.5%, 16.4%)
% families in poverty in the county	7.3% 3.8%, 12.7%)	7.0% (3.8%,10.6%)	6.4% (3.8%,11.3%)	8.1% (3.8%,12.7%)	10.2% (3.8%,12.7%)	12.7% (3.8%, 12.7%)
% Black LTCF residents in the county	0% (0%, 48%)	0% (0%, 7%)	5% (0%, 21%)	12% (6%, 48%)	21% (11%, 48%)	48% (21%, 48%)
Number nursing home beds in the county	118 (88, 142)	106 (63, 147)	117 (89, 158)	120 (99, 158)	127 (99, 129)	127 (127, 129)
Funding Characteristics						
% residents on Medicare	13% (5%, 32%)	14% (5%, 32%)	13% (1%, 31%)	14% (5%, 33%)	14% (3%, 27%)	14% (7%, 28%)
% residents on Medicaid	68% (20%, 83%)	69% (20%, 81%)	69% (20%, 84%)	66% (6%, 82%)	69% (38%, 86%)	68% (54%, 82%)
% residents with private pay	5% (.5%, 38%)	4% (0%, 33%)	7% (.1%, 49%)	7% (1%, 39%)	6% (1%, 25%)	.1% (0%, 9%)

*** denotes percentiles**
****denotes ≤ 8.9% of facilities missing data for the characteristic**
CPS: Cognitive Performance Scale

Table 7-2. Facility administrative characteristics by vaccine offered and the proportion of Black residents, Michigan, 2005-2006 influenza season

	All		Offered vaccine (Median %)	Facilities stratified by percent Blacks in the facility (%)				
	N	%		n=111 0% Blacks	n=118 0-<5% Blacks	n=100 5-<20% Blacks	n=33 20-<50% Blacks	n=41 >=50% Blacks
Type Certification								
Dually certified (Medicare and Medicaid)	276	68.5	84.2	76.6	63.6	69.0	66.7	61.0
Skilled nursing facility (SNF)/Nursing Facility (NF)- distinct part	82	20.4	78.5	8.1	28.0	22.0	27.3	22.0
Medicare only	16	4.0	61.4	4.5	2.5	5.0	6.1	2.4
Medicaid only	29	7.2	91.1	10.8	5.9	4.0	0.0	14.6
Ownership								
Profit	270	67.0	81.1	51.4	66.1	71.0	84.9	87.8
Non-profit	96	23.8	85.5	27.9	26.3	25.0	12.1	12.2
Government	37	9.2	90.3	20.7	7.6	4.0	3.0	0.0
Affiliation with Chain								
Chain	214	53.1	79.1	34.2	59.3	63.0	75.8	43.9
Independent	189	46.9	87.6	65.8	40.7	37.0	24.2	56.1
Compliance with CMS program requirements*								
Yes	381	94.8	83.8	97.3	94.9	94.0	97.0	87.5
No	21	5.2	76.5	2.7	5.1	6.0	3.0	12.5

*One facility missing information

Table 7-3. Factors contributing to vaccine offering between nursing facilities stratified by the proportion of Black residents, Michigan, 2005-2006 influenza season

	Facilities stratified by percent Blacks in the facility (%)					
	Overall	n=111 0% Blacks	n=118 0-<5% Blacks	n=100 5-<20% Blacks	n=33 20-<50% Blacks	n=41 >=50% Blacks
Proportion variability explained:	36.9	20.1	40.0	36.5	54.8	47.2
Factors contributed:						
Administrative characteristics	3.7	2.9	1.6	6.8	24.1	30.3
Total Number residents		2.6	1.6	5.5	24.1	
Total Number beds	0.7					3.8
Chain	1.4	<0.1				6.9
Ownership (Proprietary or Government)				<0.1		
Certification	1.3		<0.1			
Compliance CMS requirements	0.1	0.2		1.3		19.6
Turnover of residents	0.2					
Proportion Blacks in the facility	15.4					
Case-Mix Indicators	2.2	3.5	14.9	0.5	3.2	16.9
% diabetes			1.0		0.5	
% accidents/falls	0.2	0.4	2.6	0.5		
% poor quality of life			3.9			5.2
% speech problems	1.1	2.8	5.9			
% psychiatric problems			1.5		0.9	
% on psychotropic drugs	0.6					11.7
% renal problems	0.3	0.3			1.9	
County characteristics	0.4		3.5		0.1	
% families in poverty	0.4		3.5			
Number county beds to population					0.1	
Staff resources:	15.2	13.8	20.0	28.4	21.2	

Table 7-3. Factors contributing to vaccine offering between nursing facilities stratified by the proportion of Black residents, Michigan, 2005-2006 influenza season

	Facilities stratified by percent Blacks in the facility (%)					
	Overall	n=111 0% Blacks	n=118 0-<5% Blacks	n=100 5-<20% Blacks	n=33 20-<50% Blacks	n=41 >=50% Blacks
Proportion variability explained:	36.9	20.1	40.0	36.5	54.8	47.2
FTEs to residents				28.4	21.2	
Deficiencies					4.2	
2-Tier system of funding					2.0	

Table 7-4. Factors contributing to vaccine offering between nursing facilities stratified by the proportion of Black residents, Michigan, 2005-2006 influenza season

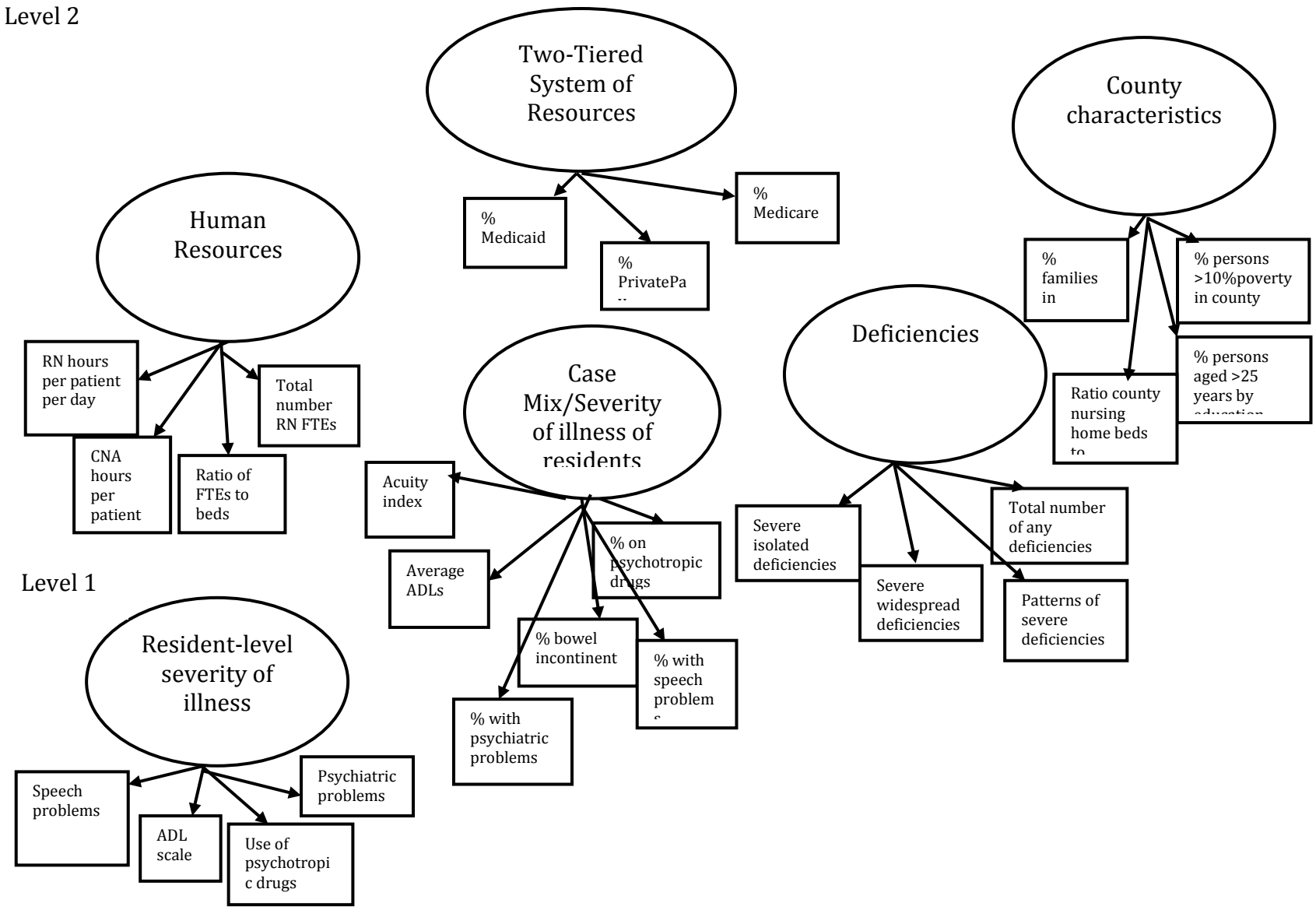
	Facilities stratified by percent Blacks in the facility coefficients (SE) for being offered vaccine					
	Overall	**n=111 0% Blacks**	**n=118 0-<5% Blacks**	**n=100 5-<20% Blacks**	**n=33 20-<50% Blacks**	**n=41 >=50% Blacks**
Administrative characteristics						
Total Number residents		-0.001 (0.001)	0.0004 (0.0004)	-0.0005 (0.0003)	-0.003 (0.001)	
Total Number beds	-.003 (0.0008)					-008 (0.003)
Chain vs independent	-0.29 (0.09)	-0.11 (0.17)				-1.06 (0.31)
Ownership						
Proprietary				0.01 (0.15)		
Government				0.49 (0.37)		
Non-profit				Ref		
Certification:						
SNF-Medicare	-0.42 (0.25)		-0.52 (0.41)	-028 (0.35)		
NF- Medicaid	0.09 (0.22)		0.09 (0.36)	0.73 (0.42)		
Dually Certified	0.02 (0.10)		0.04 (0.15)	0.20 (0.17)		
Distinct Part	Ref		ref	Ref		
Compliance CMS requirements vs non compliance	0.34 (0.18)	-0.46 (0.41)		0.47 (0.28)		1.91 (0.31)
Turnover of residents	-0.06 (0.04)					
Proportion Blacks in the facility	-1.12 (0.24)					
Case-Mix Indicators						
% diabetes			-1.68 (1.37)		3.76 (3.21)	
% accidents/falls	0.66 (0.62)	-1.39 (1.13)	2.06 (0.96)	1.52 (1.25)		
% poor quality of life			-1.64 (0.54)			2.25 (1.37)
% speech problems	1.03 (0.43)	1.46 (0.68)	1.82 (0.74)			
% psychiatric problems			1.41 (0.88)		1.17 (1.83)	

Table 7-4. Factors contributing to vaccine offering between nursing facilities stratified by the proportion of Black residents, Michigan, 2005-2006 influenza season

	Facilities stratified by percent Blacks in the facility coefficients (SE) for being offered vaccine					
	Overall	n=111 0% Blacks	n=118 0-<5% Blacks	n=100 5-<20% Blacks	n=33 20-<50% Blacks	n=41 >=50% Blacks
% on psychotropic drugs	1.19 (0.51)					4.94 (1.33)
% renal problems	-1.72 (1.04)	-2.50 (1.75)			-7.34 (4.78)	
County characteristics						
% families in poverty	-0.02 (0.01)		-0.06 (0.02)			
Number county beds to population					0.13 (0.12)	
Staff resources:						
FTEs to residents	1.49 (0.42)	1.04 (0.68)	3.44 (0.81)	1.51 (0.72)	0.04 (0.91)	
Deficiencies					0.03 (0.01)	
2-Tier system of funding						
% Private Pay					-3.63 (1.46)	
% Medicare					1.87 (1.66)	
% Medicaid					1.47 (1.04)	

Adjusted for age, gender, and race at the individual level
Note: regression coefficients are presented to indicate the direction of the relationship between the facility level variable and residents being offered vaccine in each stratum of nursing homes. Odds ratios of residents being offered the vaccine by facility level variable are not meaningful as there is no variability by facility characteristic between residents within homes

Figure 7-1.Conceptual Multilevel Model of racial composition of the nursing home, administrative factors, case-mix indicators, staff resources, facility deficiencies, and county characteristics jointly contribute to the racial gap in vaccine offering between nursing facilities in Michigan, 2005-2006



CHAPTER 8 INFLUENTIAL AUTHORITIES FOR VACCINATION POLICIES AND BARRIERS TO IMPLEMENTING STANDING ORDERS FOR INFLUENZA VACCINATION AMONG NURSING FACILITIES IN 14 STATES, 1999-2002

Background: Black nursing home residents receive influenza vaccine disproportionately less often than their White counterparts. In addition, the size of this difference in vaccination coverage grows with the proportion of Black residents within given facilities. Public health authorities recommend standing orders protocols (SOPs) for administering influenza vaccine because of their association with higher vaccine coverage. Nursing homes with SOPs have better vaccine coverage overall, in addition to no racial gap in coverage among their residents. Because the prevalence of SOPs remains low (40%) and vaccination coverage remains well below the Healthy People 2020 goals, we performed an analysis to better understand the relationships between barriers to implementing SOPs, the authorities who make the vaccination decisions, funding or resources of the facility, and race.

Methods: We evaluated the data derived from a demonstration project conducted 1999-2002 from approximately 280 participating nursing homes in 14 states. The project surveyed facilities on barriers to SOP implementation and authorities, such as physicians, quality improvement organizations (QIOs) and directors of nursing, influential in vaccination decisions internal to and outside of the facility. Using factor analysis, we determined if survey variables (indicators) and a two-tiered system (e.g., 'have' vs 'have nots') could operate as underlying factors (i.e., an unmeasured construct that drives measurable indicators). We used structural equation modeling to assess the relationships among the underlying constructs and

proportion of Black nursing home residents with implementation of SOPs and vaccination coverage.

Results: The structural equation model demonstrates a good fit (CFI= 0.954, RMSEA=0.032). Results of the structural equation model rank 'staff lacking legal authority' and 'doctors need to be educated about SOPs' as most important in the underlying construct of external facility concerns, which was significantly associated with a lower likelihood of having implemented the SOPs (p=.031). Senior facility staff being influential in vaccination decisions was directly associated with having implemented SOPs, and staff were influenced by outside authoritative bodies. The QIO followed by the state certification surveyor ranked highest on the construct of outside authoritative body with the most influence on shaping vaccination policy.

Conclusion: Our results suggest the state's QIO and the state certification surveyor may play important roles in addressing misperceptions about staff's authority to vaccinate under SOPs in educating physicians about the benefits of SOPs for influenza vaccination among nursing home residents. Facilities with larger proportions of Black residents should especially be targeted to address misperceptions as their staff have greater perceived barriers to implementing SOPs.

INTRODUCTION

Black nursing home residents disproportionately live in poorly resourced facilities that have lower quality of care processes and outcomes.[6] One study reported that Black residents disproportionately occupy nursing homes with lower influenza vaccine offering rates.[89] Reasons for facility differences in offering the vaccine remain unknown. Our analysis of the 2004 National Nursing Home Survey (NNHS) found that use of standing order protocols (SOPs) was associated with increased influenza vaccination coverage and that race strongly confounded that relationship among nursing home residents.[62] SOPs are defined as programs that authorize nurses, physician assistants, and pharmacists, where allowed by state law, to assess a client's immunization status and administer vaccinations according to an institution- or physician-approved protocol without the need for a physician's examination or direct order at the time of the interaction.[13] In settings that require physician signatures for all medications even in the presence of SOPs, such as in many long-term care settings, SOPs permit assessment and vaccination before the order is eventually signed by the physician. Thus SOPs work by reducing the burden on physicians and increasing clinical efficiency while reducing missed opportunities.

Another analysis from the 2004 NNHS indicated a small (3.7 percentage points) and non-significant racial difference (p =.145) between White and Black residents of homes with standing orders for influenza vaccinations compared to differences between White and Black residents of homes without SOPs (8.9 percentage points, p=.009).[88] Although the Advisory Committee on Immunization Practices and the Task Force for Community Preventive Services (ACIP) specifically

recommended SOPs,[53,87] only 40% of nursing home residents reportedly lived in homes with such protocols in the NNHS study. In 2002 we surveyed nursing homes in 14 states regarding use of SOPs and found nursing facilities that adopted SOPs for influenza vaccinations more likely to be government owned or non-profit, not affiliated with a chain, or dually certified by the Centers for Medicare & Medicaid Services (CMS) for both Medicare and Medicaid.[61] In the 2004 NNHS study, we also found both proprietary (i.e., for profit) nursing homes and homes affiliated with a multi-facility chain both had a higher prevalence of Black residents than White residents, and were less likely to have SOPs[88]

Little evidence has been reported to establish which authorities most influence influenza vaccination policies in nursing homes. In our previous survey of all of the nursing homes in 13 states (3,451 of 4,366 responded), we noted that facility staff reported legal concerns such as liability for the facility and that the staff lacked legal authority as significant barriers to implementing SOPs.[61]

The objectives of the present study are to determine 1) whether observed variables interrelate to measure the following constructs: types of authorities most influential in vaccination policies, barriers to implementing SOPs, and two-tiered (e.g., 'haves' and 'have nots') systems of resources, 2) if these constructs are concomitantly associated with each other, the racial composition of the facility, and with implementing SOPs, and 3) if these constructs are directly or indirectly, via implementation of SOPs, associated with vaccination coverage.

METHODS

The Centers for Disease Control and Prevention (CDC), CMS, and CMS' Quality Improvement Organizations (QIO) collaboratively conducted The Immunization Standing Orders Program Project which was a demonstration project. QIO is the tool CMS uses to conduct quality improvement activities across healthcare settings and providers nationally. The goal of the project was to have QIOs promote the use of standing orders programs among nursing facilities in order to increase immunization coverage among residents. Fourteen states participated, including DC, FL, HI, ID, KY, MA, MN, MT, NM, OH, PA, WI, SC, and NV. Twenty facilities were selected in each state. Before the start of the project, no participating states were known to have laws or regulations restricting the use of SOPs. Facilities were selected using a stratified random sampling design by facility size and the type of immunization program (oversampled for facilities with immunization standing orders). Residents eligible for inclusion lived in the facilities for any period of time during the influenza season from November 1, 2001 through January 31, 2002. One hundred residents (or all residents in facilities with < 100 residents) were randomly chosen from each facility and immunization histories were collected through on-site and archived chart abstractions. QIOs were responsible for onsite data collection and program promotion. Further information on this project has been published.[63] This analysis was approved by Emory University's Institutional Review Board.

Data sources

LTCF Survey Instrument and Data Collection

The self-administered survey included 35 questions about LTCF structural characteristics as well as policies and procedures, including immunization program

for residents, important authorities in shaping the facility's immunization policies, and the significance of barriers that prevent implementation of standing order protocols for vaccinating residents. The staff that completed the survey varied: Director of Nursing (40.6%), Infection Control Coordinator (29.9%), facility Administrator (10.3%), Assistant Director of Nursing (9.0%), and other facility staff (10.2%).

Immunization program activities were defined as "SOP" or "non-SOP" programs. "SOP" is an institutional policy that authorizes appropriate nursing or pharmacy staff to immunize residents by institution- or medical director-approved protocol without the need for a written or verbal order or an exam from the personal physician. Immunization program was operationally defined as "Non-SOP" because the program is not institution-wide (i.e., specific physician-only) or the program is institution-wide but still requires a physician order and or signature. Thus "non-SOP" programs include: "advanced orders" (i.e., an individual physician authorizes appropriate nursing staff to immunize his/her patients by his/her approved protocol without the need for an additional written or verbal order); preprinted admission orders (i.e., standardized forms included in admission package for personal physician signature which may address future as well as current vaccination needs); reminders/education (procedures in place for educating and/or reminding physicians and residents on importance of vaccinations); and usual care (residents are immunized upon request and/or upon personal physician's individual discretion, and require physician's order for each immunization).

QIOs distributed the surveys to the population of facilities in their jurisdiction, collected the completed surveys and forwarded those to the CDC. A contractor hired by the CDC then double-entered the survey data into the study database.

Other facility level data

The On-line Survey and Certification Reporting System (OSCAR) is an administrative database containing information on all Medicare or Medicaid licensed LTCFs in the U.S. The OSCAR variables included ownership (government, nonprofit, or proprietary), facility size (i.e., number of beds), if the facility had any substandard assessments,[104] if the facility was hospital-administered, type of facility (i.e., skilled nursing facility (a licensed physician supervises each patient's care and a nurse or other medical professional is almost always on the premises) or nursing facility- Medicare and/or Medicaid certified), and if the facility was independent or part of a multi-facility chain.

Vaccination coverage for the nursing home was obtained from residents' medical chart. Immunization status was aggregated for each nursing home. Racial composition of the LTCF was determined from CMS's Minimum Data Set (MDS). MDS is part of the resident assessment instrument (RAI) completed by nurses and used for assessment and care screening.[84] Instructions for completing residents' assessments include reporting race "within which the resident places self."[104]

<u>Facility questions by group</u>

Authority that influences vaccination policies

Authority that influences vaccination policies was addressed through a single question, "How important are the following authorities in shaping the facility's immunization policies? Please check for 1 = very important; 2 = important; 3 = somewhat important; 4 = not important; 5 = don't know." The following authorities were listed: ACIP, facility's medical director, quality improvement organization, state LTCF certification surveyor, state public health department, facility administrator, corporate leadership, director of nursing, and infection control coordinator. For ease of interpretation in the factor analysis, we rescaled these variables from 1 = "don't know" to 5 = "very important."

Barriers to implementation of standing order programs for immunizations

Barriers were assessed with a single question, "Rate the significance of barriers that prevent implementation of standing order programs for vaccinating LTCF residents. Please check for 1 = very significant; 2 = significant; 3 = somewhat significant; 4 = not significant; 5 = don't know." The following barriers were listed: staff lack the legal authority, lack of support of facility leadership, physicians need education about standing order programs, cost of the program (e.g., staffing requirements), low reimbursement, other priorities of staff time, medical liability concerns for the facility, and concern about inappropriate vaccination of the resident.

For ease of interpretation in the factor analysis, we rescaled these variables from 1 = "don't know" to 5 = "very significant."

Statistical Analysis

Descriptive statistics of the variables used in the factor analyses and in the multivariable (structural equation) model are presented.

Exploratory factor analysis

We explored theoretical reasons for the underlying structure of influential authorities and barriers to vaccination policies and empirically tested our hypotheses using exploratory factor analysis (EFA). We sought to determine if barriers to vaccination and influential authorities were better described as a single, underlying factor (i.e., an unmeasured construct that drives measurable indicators), multiple and independent measurable indicators, or several underlying factors consisting of multiple independent or correlated measurable indicators. We examined "scree plots" and also conducted "parallel analyses" to assess the number of factors to be modeled empirically. The final set of factors was determined by the generally accepted model fit statistics: Comparative Fit Index (CFI) > 0.95, Root Mean Square Error of Approximation (RMSEA) < 0.08, and Standardized Root Mean Square Residual (SRMR) < 0.06.[3]

The first year of the Standing Orders Project was used (2000-2001) in the exploratory factor analysis (EFA) and the variables included are in table 1a. The conceptual model that specifies the relations among concepts that are operationalized in the EFA are in Figure 8-1.

Confirmatory factor analysis

Confirmatory factor analysis (CFA) was used to 'confirm' factors identified within the EFA using the second year data from the CDC-CMS standing orders project. The second year of the Standing Orders Project was used (2001-2002)

because results of an EFA should be confirmed using a different dataset. As it is good practice to assess EFA within the dataset used to assess the CFA, we also assessed the EFA using the second year of the Standing Orders Project.

In addition to the constructs identified in the EFA, we assessed a latent construct of the two-tiered system of nursing homes established in the literature[6] with the other factors established in the EFA. We also sought to examine how the percentage of Black nursing home residents in the facility contributes to the use of standing orders and influenza vaccination coverage. Because the concept of the two-tiered system consisting of the proportions of residents on Medicaid, Medicare (Part A), and with private pay as their primary payment sources was established in the literature, we did not assess it in the EFA but did include it in the CFA.

To properly fit the model, one indicator (i.e., observed variable) was constrained to equal 1 for each latent construct tested, forcing the 'estimate' for that variable to 1. To gain a better understanding of which indicators loaded highest on the latent construct, several models were run, where we changed the constrained indicator to 1. Because proprietary or for-profit homes reportedly provide a lower quality of care[93] and some studies found Blacks more likely to live in proprietary homes than non-profit or government owned homes,[88] the final CFA model was tested for population invariance by ownership.

Structural Equation Models

After completing the confirmatory factor analysis, (i.e., the measurement model), we examined the model with other relationships to determine how the underlying (i.e., latent) factors related to one another. This combined model is

known as the structural model, which also assessed other observed variables such as the proportion of Black residents in the facility, implementation of SOPs, and vaccination coverage, in relationship to the latent factors either directly or indirectly. The second year of the Standing Orders Project was used (2001-2002). Because the structural model (i.e., the final structural equation model that includes both the measurement model and the other effects in the path considered) addresses the second objective, unstandardized estimates are presented for consistency [A binary or discrete dependent (endogenous) variable is in the final model which renders the standardized estimates inappropriate]. The unstandardized estimates include a '1' for the indicator constrained to equal 1. However, the standardized estimates do not report a '1' and thus can be used to determine the rank of importance for the indicators of each latent construct. The final test in assessing the best model fit for the CFA was the generally accepted model fit statistics: CFI > 0.95, RMSEA < 0.08, and SRMR < 0.06.

Conceptual model

The conceptual model that specifies the relations among concepts operationalized in this study can be seen in Figure 8-2. *A priori*, we predicted eleven paths to directly and/or indirectly affect implementation of standing orders and/or vaccination coverage. Nursing homes with a larger proportion of Black residents were thought to be associated with the lower of the (1) two-tiered system of resources,[6] greater barriers to SOPs both (2) internal to the facility and (3) external to the facility,[88] no (4) implementation of SOPs, and lower (5) vaccination coverage.[89] Other paths include barriers to SOPs both (6) internal to the facility and

(7) external to the facility, as well as (8) influential facility staff in vaccination policy decisions, and (9) a two-tiered system of resources thought to be associated with implementation of SOPs. A (10) two-tiered system of resources and (11) implementation of SOPs were thought to be associated with vaccination coverage.

Statistical model

The model includes five continuous latent variables where all indicators (i.e., observed variables emanating from the latent variables) of latent variables are continuous. Of the three observed non-indicator variables (i.e., observed variables NOT emanating from a latent variable) in the model, two are continuous and one variable (implementation of SOPs) is binary. Because the binary variable is endogenous (i.e., a dependent variable), the model necessitates a special estimation method. Also, unstandardized estimates are presented due to the nonlinear aspect of the model. In addition, because of the one categorical variable in the model, presenting a sample covariance matrix can lead to incorrect statistical reference, and is not appropriate for SEM analyses in this context.[130]

Estimation and Fit Criteria

The best method of estimation for a model with categorical variables and a sample size greater than 200 is a robust weighted least squares also known as the weighted least-squares with mean and variance adjustment (WLSMV).[131] Fit criteria include indices such as the CFI, the Tucker-Lewis Index (TLI), RMSEA, and Weighted Root Mean Square Residual (WRMR). The robust WLSMV X^2 used by Mplus performs well, but its use as a sole measure of fit is problematic due to its sensitivity to sample size.[132] Therefore the fit statistics include: 1) RMSEA which is a

function of the chi-square or test of close fit—a value of less than .05/.06 is recommended; 2) WRMR which is a weighted average of the residuals—a value of less than 1 is recommended;[133] 3) CFI >.95; 4) TLI >.95; and 5) X^2 goodness of fit test, $p > .05$.

RESULTS

Response rate

For the survey part of the analyses the response rate for 2000 was 89% (249 of the 279 eligible nursing homes). The second year of the study (2002) the response rate was also 89% (236 of the 266 facilities). Six of the nursing homes in the second year did not have complete information on SOPs or the questions used for the factor analyses, yielding a sample size of 230.

Descriptive statistics

Over half of the nursing homes were proprietary (53.4%), affiliated with a chain (52.6%) or dually certified for Medicare and Medicaid (52.6%) [Table 8-1a]. The Infection Control Coordinator (58.2%) and the Director of Nursing (57.0%) were the most frequently reported authorities to be 'very important' in influencing vaccination policies during the first year of the demonstration project (EFA analysis) [Table 8-1b]. In the pre- and post-intervention survey years of the nursing homes, the most frequently reported 'very significant' barrier to implementing standing orders for immunizations was 'staff lack legal authority to vaccinate without a physician order' (34.8% in year 1 and 27.4% in year 2). [Tables 8-1b and 8-1c]. Among the 234 nursing homes with complete data, the average proportion of residents on Medicare was 12% and on Medicaid was 67% [Table 8-2]. Among the

236 nursing homes with complete data, the average proportion of Black residents was 9% and the average number was 14.4.

In the first year of the study, 42 (16.9%) of the 249 nursing homes had SOPs (i.e., were early adopters of SOPs). Median vaccination coverage among early adopters of SOPs was 71.4% in year 1 and 70.9% in year 2. Nursing homes that adopted SOPs after the intervention (i.e., "late adopters," n=25) were those homes in the study both years that did not have SOPs in year 1 but adopted them after the intervention. Among late adopters, vaccination coverage was 66.3% in year 1, compared with 64.0% in the second year. Vaccination coverage was lower in both years among nursing homes that had not adopted SOPs (median coverage year 1: 63.6% and year 2: 62.9%). More government owned homes (30.3%) had SOPs in the second year of the demonstration project than proprietary (25.2%) or non-profit homes (18.9%).

Of the 42 facilities that had SOPs in the first year, 30 also responded to the survey in the second year. In both the first and second years of the SOP Project, the Infection Control Coordinator was the most frequently reported official as being 'very important' in shaping their facility's vaccination policies (58.2% in the first year and 59.1% in the second year). [Tables 8-1a, 8-1b] The Director of Nursing (57.0% in the first year and 59.0% in the second year) was reported to be almost as important as the Infection Control Coordinator. In both years, staff lacking legal authority to vaccinate without a physician order was perceived as a 'very significant' barrier to prevent implementation of standing order programs

Exploratory factor analysis

Results of the exploratory factor analysis identified five latent constructs. In rank order highest to lowest these were: 1) two-tiered systems of funding resources included the proportion of residents on Medicaid in the facility, the proportion of residents in the facility with private payment source, and the proportion of residents in the facility on Medicare; 2) authoritative bodies who shape vaccination decisions included state certification surveyor, the QIO, state health department, and the ACIP; 23) senior staff who shape vaccination decisions included director of nursing, infection control coordinator, medical director, and facility administrator; 4) internal facility barriers to implementing SOPs included cost of the program, low reimbursement, staff have other priorities of their time, and lack of support of facility leadership; and 5) external facility concerns included concerns about medical liability for the facility, concerns of inappropriately vaccinating residents, staff may lack legal authority to immunize without resident's physician order, and need to educate physician about standing orders programs. Specific details of the analysis are in appendix 3.

Confirmatory factor analysis models

The five-factor model for the latent constructs identified in the EFA was an excellent fit when confirmed with the CFA: the CFI was 1.0; RMSEA was 0.00 (CI: 0.000, 0.025) and the SRMR was 0.041. The model results are in table 3.

In the CFA the indicators' rank of importance changed for the five latent constructs identified in EFA. Also, the rank order of importance of indicators changed depending on which variable was constrained to equal 1. It is necessary to constrain one variable to unity to give the latent variable the same metric as the

indictor (i.e., observed variable).[4] However, constraining the observed variable from allowing it to vary freely may affect the other variability of the other observed variables. Therefore, the model was run several times to assess changes in rank order by changing which variable was constrained to equal unity. The standardized estimates suggest that of the external facility concerns that are barriers to implementing SOPs, the most important indicator is that doctors need to be educated about SOPs (0.784, $p<.01$), followed by concerns about medical liability to the facility (0.703, $p<.01$) when 'staff lack legal authority' is constrained to unity. When 'doctors need to be educated about SOPs' is constrained to equal 1 then 'staff lack legal authority' ranks as the most important barrier.

For the internal barriers to SOPs, lack of support of facility leadership was ranked the most significant (0.764, $p<.01$), followed by cost of the program (0.748, $p<.01$). For the authoritative body influential in vaccination policies, the QIO was ranked the most important (0.784, $p<.01$), followed by the state nursing home certification surveyor (0.746, $p<.01$). For the facility staff most influential in vaccination decisions, the medical director was ranked the highest (0.769, $p<.01$), followed by the facility administrator (0.706, $p<.01$).

The final 5-factor CFA model was fit to determine if there was population invariance by ownership. However, due to the small sample size after stratifying by ownership (profit vs nonprofit/government) the models would not converge. Therefore we could not assess population invariance.

Structural Equation Models

Indicators of Overall Fit

All the fit statistics indicated the structural equation model was a good fit. First, the RMSEA was 0.023, below the recommended.05 or.06. Second, the WRMR was 0.700, below the recommended 1.0. Third, the CFI was 0.967, above the recommended >.95. Fourth, the TLI was 0.957, greater than the recommended >.95. Finally, the X^2 goodness of fit test was 219.43, 196 df, p=0.1205, above the recommended $p > .05$.

Parameter Estimates

Estimates of the final measurement model are in Figure 8-3 and estimates of the structural model are in Figure 8-4. Statistically significant paths have bolded arrows and italicized estimates. In the structural model, vaccination coverage was 7.7 percentage points higher in facilities with SOPs compared with facilities without SOPs (p=.001). The construct, liability and legal concerns, was associated as a significant barrier to implementing SOPs (p=.001). For every unit increase in the latent construct of liability and legal concerns, the odds of implementing SOPs decreased by 0.51. Higher proportions of Black residents were significantly associated with the construct, internal facility barriers to SOPs (p=.018). The construct, external facility concerns as perceived barriers to SOPs, was significantly associated with both constructs for influential authorities in vaccination policy decisions: with outside authoritative body (p=.012) and senior staff (p<.001). The construct, influential senior staff who make vaccination policy decisions, was significantly associated with the construct, influential outside authoritative bodies who make vaccination decisions (p<.001).

Alternative Models

Seven of the 11 paths tested based on our *a priori* hypotheses were supported by the final model. Lack of implementation of SOPs was not directly associated with: 1) higher proportion of Black residents, 2) two-tiered system of resources, or 3) internal facility barriers to SOPs. Vaccination coverage was likewise not associated with those three variables. However, both these latent constructs, the two-tiered system of resources and internal facility barriers to SOPs, correlated with the other three latent constructs and improved the overall fit of the model. The chi-square difference testing could not be used because a difference between two scaled (for non-normality) chi-squares for nested models is not distributed as chi-square.

DISCUSSION

As found in our national study,[62] use of SOPs was significantly associated with greater vaccination coverage. However, in our national study the adjusted difference in vaccination coverage for residents in homes with standing orders compared to those without standing orders was more modest--only 4.7 rather than the 7.7 percentage points that we report here.[62] As hypothesized, the construct for external facility concerns, which included concern for liability and legal issues, was negatively associated with implementing SOPs. The construct for perceived external facility concerns acting as barriers to SOPs was also significantly correlated with outside authoritative bodies that shape vaccination policy. In addition, the construct, influential staff who shape vaccination policies, was significantly correlated with the construct of influential outside authoritative bodies for vaccination policies. Having a higher proportion of Black residents was significantly associated with the construct for internal facility barriers to SOPs, such as costs, but

the construct for internal facility barriers was not associated with implementation of SOPs.

Vaccination coverage was higher among facilities with SOPs (7.7 percentage points) than facilities without SOPs. In a previous analysis of this study, we found facilities that adopted SOPs after the QIO interventions did not significantly increase their vaccination coverage by 10% or more from one year to the next.[63] Because SOPs were associated with higher coverage than other vaccination programs in the second year, these findings may indicate that the early adopters of SOPs had consistently higher vaccination coverage (median vaccination coverage: year 1=71.0% and year 2=70.9%) than facilities that adopted SOPs later (median vaccination coverage: year 1=66.3% and year 2=64.0%). It may be that coverage increases slowly because changing attitudes towards SOPs may take longer than one influenza season. The SOP is likely to be effective if all levels of staff are willing to implement the protocol, especially if the staff who originally implemented the policy remain with the facility to see it through. It could be that late adopters also had higher staff turnover.

Perceived external facility concerns were negatively associated with SOP implementation, but this association may be mitigated to some degree by the fact that outside bodies influence vaccination policies and senior staff are also influenced by outside bodies. The outside authoritative body that had the most influence on shaping vaccination policy was the QIO, followed by the state certification surveyor. Therefore those authorities are best positioned to address the perceived barriers –especially the fear that a physician signature is needed or

the physician and/or nursing home will be at risk for litigation. The National Vaccine Injury Compensation Program, a no-fault dispute resolution system for resolving vaccine injury claims, was established in 1988 to compensate individuals and families injured by vaccines.[134] Because of this program, the perceived concern about medical liability for the nursing home should be assuaged. Messages to address this fact should be clearly delivered by the QIO and state certification surveyor.

The external concern about doctors in need of education about SOPs may have to do with physician unwillingness to give up the need for their signature for vaccination. For example, this may have to do with physicians' concern that SOPs may apply too broad an approach, inappropriately targeting some individuals for vaccine who do not need it or for whom it is contraindicated. Because the highest ranking external concern changed with the variable chosen to be constrained, both variables, doctors in need of education about SOPs and staff lacking legal authority, are important contributors to the underlying latent variable. These concerns deserve further research to understand their relative impact and how to remove them as barriers to improving SOP utilization.

In our model, internal facility barriers such as perceived low reimbursement and the cost of implementing the program to the facility were not associated with implementing SOPs. In fact, including internal barriers led to a more poorly fitting model and therefore was not in a path to implementation of SOPs. At the time of our study, CMS (Medicare) did not reimburse nursing homes with SOPs for the influenza vaccine. Importantly, CMS removed that policy in October, 2002 and has since

reimbursed facilities that have SOPs for vaccinations.[135] To our knowledge only seven states still have laws against use of SOPs, even though SOPs are recommended by the ACIP.[136]

The proportion of Black residents in the facility was associated with the latent factors for internal facility barriers to implementing SOPs. Other studies have found that the higher the proportion of Black residents in the nursing home the lower the likelihood of being offered the vaccine as well as receiving the vaccine.[89] Thus this finding highlights the importance of addressing internal barriers to implementing SOPs in nursing homes, particularly in the predominantly Black homes. Also, the higher the proportion of Black residents in the nursing home the higher the likelihood of perceived barriers related to the cost of the program, low reimbursement, and other priorities of staff time. This finding confirms with other evidence that the predominantly Black homes are likely to be poorly resourced nursing homes. In another analysis we found that the nursing homes with higher proportions of Black residents had lower ratios of FTEs to beds and lower RN and direct-care staff hours per resident day. (CDC, unpublished)

It is concerning that the proportion of Black residents in the facility was also significantly associated with external facility barriers, as those barriers were significantly associated with not implementing SOPs. Homes with majority Black residents should particularly be targeted for policy changes, as discussed previously.

Limitations

A limitation of the study is the small ratio of "sample size to number of parameters" in the model. Due to lack of power we may have failed to detect statistically significant paths in our best fitting structural model. However, because the statistically non-significant paths are theoretically sound and the model was a good fit, it is reasonable to assume those paths are important in the model overall; future research should investigate these paths. Also, although some of the variables in our analyses were aggregated to the facility level (e.g., proportion Black residents and vaccination coverage), the research questions were intended to make inferences at the facility level. We would not expect the inability to control for resident-level characteristics to affect facility-level authorities who shape decisions for vaccination or barriers to implementation of SOPs.

It is important to note that although this study was a demonstration project to encourage nursing homes to adopt standing orders for immunizations, the underlying constructs such as barriers to implementing standing orders do not change from one year to the next because of the demonstration project. In other words, a facility may or may not adopt an SOP for vaccinations due to the influence of the QIO's interventions, but the relationship of the perceived barriers and how they 'load on' or define the underlying (latent) constructs should not change much from one year to the next, unless experience with implementation of SOPs affects perceptions. We performed confirmatory factor analysis using data from the second year of the Standing Orders Project to confirm our findings from the exploratory factor analysis using the first year of data. Therefore, examining the research questions in the second year would not theoretically vary from the results had we

done the confirmatory factor analysis and the structural equation models in the first year. Because the latent constructs were defined or 'explored' in the first year, it would not be appropriate to conduct the CFA and SEM in that year.

Conclusions

The contribution of this study is in identifying that perceived external facility concerns are barriers to implementation of SOPs. Our findings also confirm the importance of SOPs for increasing vaccination coverage. Further, because authorities such as QIOs and the state certification surveyor are influential in shaping vaccination policies, they should be encouraged to address perceived concerns by the nursing homes. Addressing these concerns may increase use of SOPs and thereby increase vaccination coverage among nursing home residents, which remains well below the Healthy People goals of 90%.

Table 8-1a. CMS – CDC Standing Orders Project, Facility Characteristics, 2000-2001

	All	
	N= 249	%
Ownership		
Government	31	12.5
Profit	133	53.4
Non-profit	85	34.1
Certification		
SNF- Medicare	11	4.0
NF-Medicaid	10	4.4
Dually Certified	131	52.6
Distinct Part	97	39.0
Affiliated with chain		
Independent	118	47.4
Chain	131	52.6
Hospital administered?		
No	205	82.3
Yes	44	17.7
Standing orders for influenza vaccination		
Yes	42	16.9
No	207	83.1
Proportion Residents with Medicare as Primary payment source	Median =8.1%	
Proportion Residents with Medicaid as Primary payment source	Median=70.2%	
Proportion Residents with Private Pay as Primary payment source	Median=21.9%	

Table 8-1b. CMS – CDC Standing Orders Project, Influential Authorities and Barriers to Implementing Standing Orders Protocols, 2000-2001

How important are authorities in shaping the facility's immunization policies?					
	Don't know n (%)	Not important n (%)	Somewhat important n (%)	Important n (%)	Very important n (%)
Director of Nursing	5 (2.0)	2 (0.8)	20 (8.0)	80 (32.1)	142 (57.0)
Infection Control Coordinator	9 (3.6)	1 (0.4)	18 (7.2)	76 (30.5)	145(58.2)
Advisory Committee for Immunization Practices	25 (10.0)	4 (1.6)	23 (9.2)	80 (32.1)	117 (47.0)
Facility Administrator	9 (3.6)	12 (4.8)	33 (13.3)	96 (38.6)	99 (39.8)
Corporate Leadership	32 (12.9)	33 (13.3)	35 (14.1)	77 (30.9)	72 (28.9)
State Health Department	19 (7.6)	9 (3.6)	35 (14.1)	86 (34.5)	100 (40.2)
Medical Director	4 (1.6)	7 (2.8)	35 (14.1)	109 (43.8)	94 (37.8)
Quality Improvement Organization	63 (25.3)	15 (6.0)	48 (19.3)	84 (33.70)	39 (15.7)
State certification surveyor	25 (10.0)	17 (6.8)	33 (13.3)	68 (27.3)	106 (42.6)
How significant is barrier to prevent implementation of standing order programs for vaccinating residents of your facility?					
	Don't know n (%)	Not significant n (%)	Somewhat significant n (%)	Significant n (%)	Very significant n (%)
Doctors need education about standing orders	18 (7.2)	128 (51.4)	31 (12.5)	42 (16.9)	30 (12.1)
Concerns about medical liability for the facility	19 (7.6)	141 (56.6)	41 (16.5)	28 (11.2)	20 (8.0)
Cost of Program	18 (7.2)	170 (68.3)	33 (13.3)	19 (7.6)	9 (3.6)
Concerns about inappropriately vaccinating residents	20 (8.0)	114 (45.8)	59 (23.7)	33 (13.3)	23 (9.2)
Lack of support of facility leadership	18 (7.2)	177 (71.1)	22 (8.8)	19 (7.6)	13 (5.2)
Low reimbursement	31 (12.5)	162 (65.1)	29 (11.7)	17 (6.8)	10 (4.0)
Other priorities of staff	17 (6.8)	142 (57.0)	48 (19.3)	32 (12.9)	10 (4.0)
Staff lack legal authority to vaccinate without a physician order	22 (8.8)	72 (28.9)	25 (10.0)	46 (18.5)	84 (33.7)

Table 8-1c. CMS-CDC Standing Orders Project, Facility characteristics by use of SOPs, Vaccination Coverage, and proportion Blacks in the facility, 2001-2002

	All		Standing orders for influenza vaccination				Influenza vaccination coverage			% Blacks in facility		
			No		Yes							
	n= 230	%	n	%	n	%	n	Mean	Median	n	Mean	Median
Ownership												
Profit	123	0.53	92	0.75	31	0.25	123	0.53	0.57	123	0.09	0.02
Government	33	0.14	23	0.70	10	0.30	33	0.75	0.77	33	0.09	0.00
Non-profit	74	0.32	60	0.81	14	0.19	74	0.64	0.69	74	0.07	0.00
Certification												
Dual certif.	160	0.70	123	0.77	37	0.23	160	0.63	0.66	160	0.07	0.00
Distinct Part	53	0.23	40	0.75	13	0.25	53	0.50	0.49	53	0.15	0.03
SNF- Medicare	7	0.03	7	1.00	0	0.00	7	0.30	0.27	7	0.10	0.04
NF-Medicaid	10	0.04	5	0.50	5	0.50	10	0.80	0.82	10	0.02	0.00
Chain?												
Independent	109	0.47	82	0.75	27	0.25	109	0.66	0.72	109	0.10	0.00
Multi-facility Chain	121	0.53	93	0.77	28	0.23	121	0.54	0.59	121	0.07	0.01
Hospital administered?												
No	191	0.83	144	0.75	47	0.25	191	0.60	0.64	191	0.08	0.01
Yes	39	0.17	31	0.79	8	0.21	39	0.58	0.67	39	0.08	0.00
Substandard assessments												
No	175	0.76	131	0.75	44	0.25	175	0.60	0.64	175	0.07	0.01
Yes	50	0.22	39	0.78	11	0.22	50	0.57	0.65	50	0.12	0.01
How important are authorities in shaping the facility's immunization policies?												
Director of Nursing												
Don't know	1	<0.01	1	1.00	0	0.00	1	0.53	0.53	1	0.01	0.01
Not important	2	<0.01	2	1.00	0	0.00	2	0.49	0.49	2	0.09	0.09
Somewhat important	14	0.06	10	0.71	4	0.29	14	0.54	0.67	14	0.06	0.00
Important	78	0.34	62	0.79	16	0.21	78	0.58	0.62	78	0.05	0.00
Very important	135	0.59	100	0.74	35	0.26	135	0.62	0.66	135	0.10	0.01
Infection Control Coordinator												
Don't know	5	0.02	5	1.00	0	0.00	5	0.49	0.43	5	0.24	0.02
Not important	4	0.02	3	0.75	1	0.25	4	0.53	0.57	4	0.03	0.03
Somewhat important	13	0.06	10	0.77	3	0.23	13	0.53	0.66	13	0.12	0.01
Important	72	0.31	59	0.82	13	0.18	72	0.58	0.63	72	0.08	0.01
Very important	136	0.59	98	0.72	38	0.28	136	0.62	0.66	136	0.08	0.01
Advisory Committee for Immunization Practices												
Don't know	16	0.07	13	0.81	3	0.19	16	0.54	0.57	16	0.13	0.01

Table 8-1c. CMS-CDC Standing Orders Project, Facility characteristics by use of SOPs, Vaccination Coverage, and proportion Blacks in the facility, 2001-2002

	All		Standing orders for influenza vaccination				Influenza vaccination coverage			% Blacks in facility		
			No		Yes							
	n= 230	%	n	%	n	%	n	Mean	Median	n	Mean	Median
Not important	4	0.02	4	1.00	0	0.00	4	0.78	0.76	4	0.01	0.00
Somewhat important	21	0.09	15	0.71	6	0.29	21	0.55	0.62	21	0.03	0.00
Important	77	0.33	60	0.78	17	0.22	77	0.59	0.64	77	0.09	0.01
Very important	112	0.49	83	0.74	29	0.26	112	0.62	0.67	112	0.09	0.01
Facility Administrator												
Don't know	2	<0.01	1	0.50	1	0.50	2	0.66	0.66	2	0.00	0.00
Not important	16	0.07	14	0.88	2	0.12	16	0.63	0.69	16	0.02	0.00
Somewhat important	27	0.12	17	0.63	10	0.37	27	0.59	0.66	27	0.02	0.00
Important	92	0.40	73	0.79	19	0.21	92	0.60	0.64	92	0.07	0.01
Very important	93	0.40	70	0.75	23	0.25	93	0.59	0.64	93	0.13	0.01
Corporate Leadership												
Don't know	35	0.15	25	0.71	10	0.29	35	0.69	0.73	35	0.04	0.00
Not important	26	0.11	20	0.77	6	0.23	26	0.71	0.73	26	0.09	0.00
Somewhat important	31	0.13	20	0.65	11	0.35	31	0.56	0.62	31	0.03	0.00
Important	73	0.32	58	0.79	15	0.21	73	0.57	0.61	73	0.11	0.01
Very important	65	0.28	52	0.80	13	0.20	65	0.56	0.61	65	0.11	0.02
State Health Department												
Don't know	13	0.06	11	0.85	2	0.15	13	0.60	0.61	13	0.08	0.00
Not important	13	0.06	12	0.92	1	0.08	13	0.61	0.64	13	0.01	0.00
Somewhat important	31	0.13	22	0.71	9	0.29	31	0.53	0.58	31	0.04	0.00
Important	101	0.44	78	0.77	23	0.23	101	0.63	0.67	101	0.09	0.01
Very important	72	0.31	52	0.72	20	0.28	72	0.58	0.64	72	0.10	0.01
Medical Director												
Don't know	1	<0.01	0	0.00	1	1.0	1	0.92	0.92	1	0.00	0.00
Not important	9	0.04	7	0.78	2	0.22	9	0.61	0.71	9	0.07	0.00
Somewhat important	36	0.16	32	0.89	4	0.11	36	0.54	0.60	36	0.05	0.01
Important	93	0.40	69	0.74	24	0.26	93	0.61	0.64	93	0.06	0.01
Very important	91	0.40	67	0.74	24	0.26	91	0.61	0.65	91	0.12	0.01
Quality Improvement Organization												
Don't know	31	0.13	27	0.87	4	0.13	31	0.60	0.62	31	0.04	0.01
Not important	11	0.05	10	0.91	1	0.09	11	0.71	0.78	11	0.04	0.00
Somewhat important	36	0.16	25	0.69	11	0.31	36	0.59	0.65	36	0.08	0.00
Important	107	0.47	83	0.78	24	0.22	107	0.60	0.64	107	0.10	0.01

Table 8-1c. CMS-CDC Standing Orders Project, Facility characteristics by use of SOPs, Vaccination Coverage, and proportion Blacks in the facility, 2001-2002

	All		Standing orders for influenza vaccination				Influenza vaccination coverage			% Blacks in facility		
			No		Yes							
	n= 230	%	n	%	n	%	n	Mean	Median	n	Mean	Median
Very important	45	0.20	30	0.67	15	0.33	45	0.58	0.64	45	0.09	0.01
State Certification Surveyor												
Don't know	14	0.06	12	0.86	2	0.14	14	0.59	0.61	14	0.01	0.00
Not important	20	0.09	16	0.80	4	0.20	20	0.67	0.72	20	0.04	0.00
Somewhat important	30	0.13	17	0.57	13	0.43	30	0.55	0.56	30	0.04	0.00
Important	83	0.36	70	0.84	13	0.16	83	0.59	0.63	83	0.09	0.01
Very important	83	0.36	60	0.72	23	0.28	83	0.61	0.66	83	0.12	0.01
How significant is barrier to prevent implementation of standing order programs for vaccinating residents of your facility?												
Doctors need education about standing orders												
Don't know	9	0.04	7	0.78	2	0.22	9	0.69	0.66	9	0.01	0.00
Not significant	117	0.51	78	0.67	39	0.33	117	0.64	0.68	117	0.07	0.00
Somewhat significant	35	0.15	31	0.89	4	0.11	35	0.58	0.65	35	0.10	0.02
Significant	45	0.20	39	0.87	6	0.13	45	0.53	0.57	45	0.10	0.01
Very significant	24	0.10	20	0.83	4	0.17	24	0.54	0.62	24	0.14	0.03
Concerns about medical liability for the facility												
Don't know	16	0.07	14	0.88	2	0.12	16	0.60	0.67	16	0.06	0.00
Not significant	106	0.46	73	0.69	33	0.31	106	0.61	0.66	106	0.07	0.00
Somewhat significant	56	0.24	43	0.77	13	0.23	56	0.58	0.63	56	0.09	0.01
Significant	30	0.13	24	0.80	6	0.20	30	0.56	0.57	30	0.08	0.00
Very significant	22	0.10	21	0.95	1	0.04	22	0.63	0.64	22	0.13	0.03
Cost of program												
Don't know	12	0.05	11	0.92	1	0.08	12	0.64	0.64	12	0.04	0.01
Not significant	146	0.63	106	0.73	40	0.27	146	0.63	0.67	146	0.07	0.01
Somewhat significant	30	0.13	21	0.70	9	0.30	30	0.54	0.59	30	0.07	0.01
Significant	29	0.13	26	0.90	3	0.10	29	0.53	0.57	29	0.12	0.00
Very significant	13	0.06	11	0.85	2	0.15	13	0.48	0.46	13	0.19	0.01
Concerns about inappropriately vaccinating residents												
Don't know	10	0.04	8	0.80	2	0.20	10	0.67	0.72	10	0.02	0.00
Not significant	91	0.40	63	0.69	28	0.31	91	0.62	0.67	91	0.06	0.00
Somewhat significant	63	0.27	47	0.75	16	0.25	63	0.58	0.60	63	0.10	0.01

Table 8-1c. CMS-CDC Standing Orders Project, Facility characteristics by use of SOPs, Vaccination Coverage, and proportion Blacks in the facility, 2001-2002

	All		Standing orders for influenza vaccination				Influenza vaccination coverage			% Blacks in facility		
			No		Yes							
	n= 230	%	n	%	n	%	n	Mean	Median	n	Mean	Median
Significant	37	0.16	31	0.84	6	0.16	37	0.61	0.63	37	0.06	0.01
Very significant	29	0.13	26	0.90	3	0.10	29	0.54	0.61	29	0.16	0.04
Lack of support of facility leadership												
Don't know	10	0.04	8	0.80	2	0.20	10	0.65	0.67	10	0.02	0.00
Not significant	155	0.67	112	0.72	43	0.28	155	0.62	0.66	155	0.07	0.01
Somewhat significant	26	0.11	21	0.81	5	0.19	26	0.54	0.59	26	0.03	0.00
Significant	25	0.11	21	0.84	4	0.16	25	0.55	0.63	25	0.18	0.01
Very significant	14	0.06	13	0.93	1	0.07	14	0.58	0.64	14	0.16	0.04
Low reimbursement												
Don't know	23	0.10	19	0.83	4	0.17	23	0.52	0.62	23	0.07	0.02
Not significant	145	0.63	102	0.70	43	0.30	145	0.64	0.67	145	0.08	0.01
Somewhat significant	28	0.12	25	0.89	3	0.11	28	0.58	0.58	28	0.08	0.00
Significant	22	0.10	19	0.86	3	0.14	22	0.54	0.58	22	0.09	0.00
Very significant	12	0.05	10	0.83	2	0.17	12	0.47	0.53	12	0.20	0.03
Other priorities of staff												
Don't know	11	0.05	9	0.82	2	0.18	11	0.64	0.69	11	0.03	0.01
Not significant	111	0.48	79	0.71	32	0.29	111	0.60	0.66	111	0.09	0.01
Somewhat significant	43	0.19	32	0.74	11	0.26	43	0.61	0.66	43	0.08	0.00
Significant	42	0.18	36	0.82	6	0.14	42	0.57	0.61	42	0.09	0.00
Very significant	23	0.10	19	0.83	4	0.17	23	0.62	0.64	23	0.07	0.00
Staff lack legal authority to vaccinate without a physician order												
Don't know	14	0.06	11	0.78	3	0.21	14	0.67	0.65	14	0.07	0.00
Not significant	77	0.33	45	0.58	32	0.42	77	0.65	0.68	77	0.07	0.00
Somewhat significant	25	0.11	18	0.72	7	0.28	25	0.60	0.64	25	0.03	0.01
Significant	51	0.22	47	0.92	4	0.08	51	0.57	0.60	51	0.10	0.01
Very significant	63	0.27	54	0.86	9	0.14	63	0.54	0.62	63	0.10	0.02
Facility has written protocol for vaccination policy												
No	54	0.23	43	0.80	11	0.20	54	0.58	0.64	54	0.05	0.00
Yes	176	0.77	132	0.75	44	0.25	176	0.61	0.64	176	0.09	0.01

Table 8-2. CMS-CDC Standing Orders Project, Descriptive Statistics, 2001-2002

	N	Mean	Median
Number of residents	236	134.76	118.00
Facility Acuity index	233	10.23	10.13
Median facility CMI	232	0.91	0.91
Proportion residents on Medicare	234	0.12	0.09
Proportion residents on Medicaid	234	0.67	0.70
Number of Black residents in the facility	236	14.39	1.00
Number of White residents in the facility	236	104.97	89.00
Occupancy rate	234	0.85	0.92
Influenza vaccination coverage	232	0.60	0.64
% Blacks in facility	234	0.09	0.01
Proportion residents with private pay	234	0.23	0.19
Number RN FTE hours per day	234	57.70	45.85

Table 8-3. CMS-CDC Standing Orders Immunization Project, 2001-2002: Confirmatory Factor Analysis

Estimates from the Confirmatory Factor Analysis
Population means (n=234 nursing homes)

	Unstandardized Estimate (SE)	Standardized	P-value	Mean ± SD
Tiered System of Resources				
1 % Residents with Medicare	1.00 (0.00)	0.65 (0.23)	-	0.13 ± 0.15
2 % Residents with Medicaid	-1.77 (1.24)	-0.83 (0.28)	0.153	0.66 ± 0.21
3 % Residents with Private Pay	1.34 (1.36)	0.72 (0.47)	0.325	0.24 ± 0.18
Internal Barriers to SOPs (scale 1 (low) to 5 (highly) significant barrier)				
4 Lack of support of facility leadership	1.00 (0.00)	0.76 (0.05)	-	2.44 ± 0.97
5 Cost program (e.g., retraining staff, admin time)	0.99 (0.13)	0.75 (0.07)	<.001	2.47 ± 0.98
6 Low reimbursement .	0.94 (0.15)	0.72 (0.08)	<.001	2.35 ± 0.98
7 Other priorities of staff time	1.01 (0.15)	0.67 (0.07)	<.001	2.77 ± 1.12
External Facility Barriers to SOPs (scale 1 (low) to 5 (highly) significant barrier)				
8 Need to educate physicians about SOPs	1.00 (0.00)	0.78 (0.04)	-	2.79 ± 1.13
9 Medical liability to the facility	0.86 (0.14)	0.70 (0.05)	<.001	2.69 ± 1.10
10 Inappropriately vaccinating resident	0.68 (0.12)	0.58 (0.06)	<.001	2.90 ± 1.13
11 Staff lack legal authority to immunize without physician order	0.98 (0.18)	0.64 (0.05)	<.001	3.27 ± 1.36
Authoritative body influences vaccination policies (scale 1 (low) to 5 (highly) important)				
12 Corporate Leadership	1.00 (0.00)	0.44 (0.07)	-	3.42 ± 1.42
13 State Public Health Department (SPHD)	1.31 (0.28)	0.74 (0.05)	<.001	3.85 ± 1.14
14 State nursing home certification surveyors	1.51 (0.33)	0.75 (0.04)	<.001	3.83 ± 1.22
15 Advisory Committee on Immunization Practices (ACIP)	1.16 (0.29)	0.63 (0.06)	<.001	4.10 ± 1.18
16 Quality Improvement Organization (QIO)	1.75 (0.38)	0.78 (0.04)	<.001	3.50 ± 1.28
LTCF staff influence vaccination policies (scale 1 (low) to 5 (highly) important)				
17 Medical director	1.00 (0.00)	0.77 (0.06)	-	4.10 ± 0.94
18 Infection Control Coordinator	0.76 (0.12)	0.58 (0.08)	<.001	4.38 ± 0.95
19 Director of Nursing (DON)	0.80 (0.11)	0.70 (0.07)	<.001	4.44 ± 0.82
20 Facility administrator	0.98 (0.12)	0.71 (0.07)	<.001	4.07 ± 1.01

Figure 8-1. Conceptual Model of Barriers to implementing standing orders for vaccinations, influential authorities for vaccination policies and two-tiered system of resources

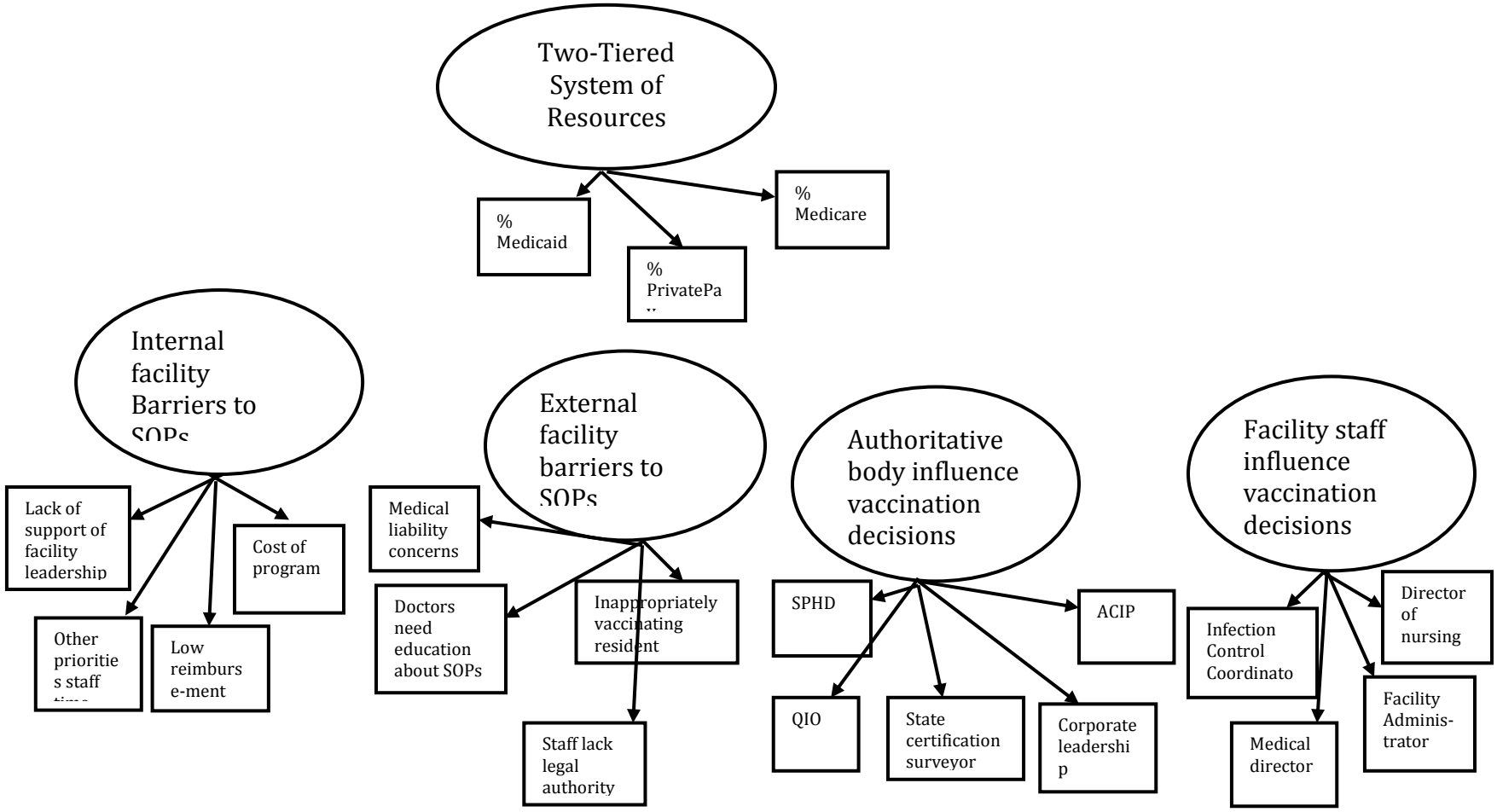


Figure 8-2.Conceptual Model of Relationships tested in Structural Equation Model

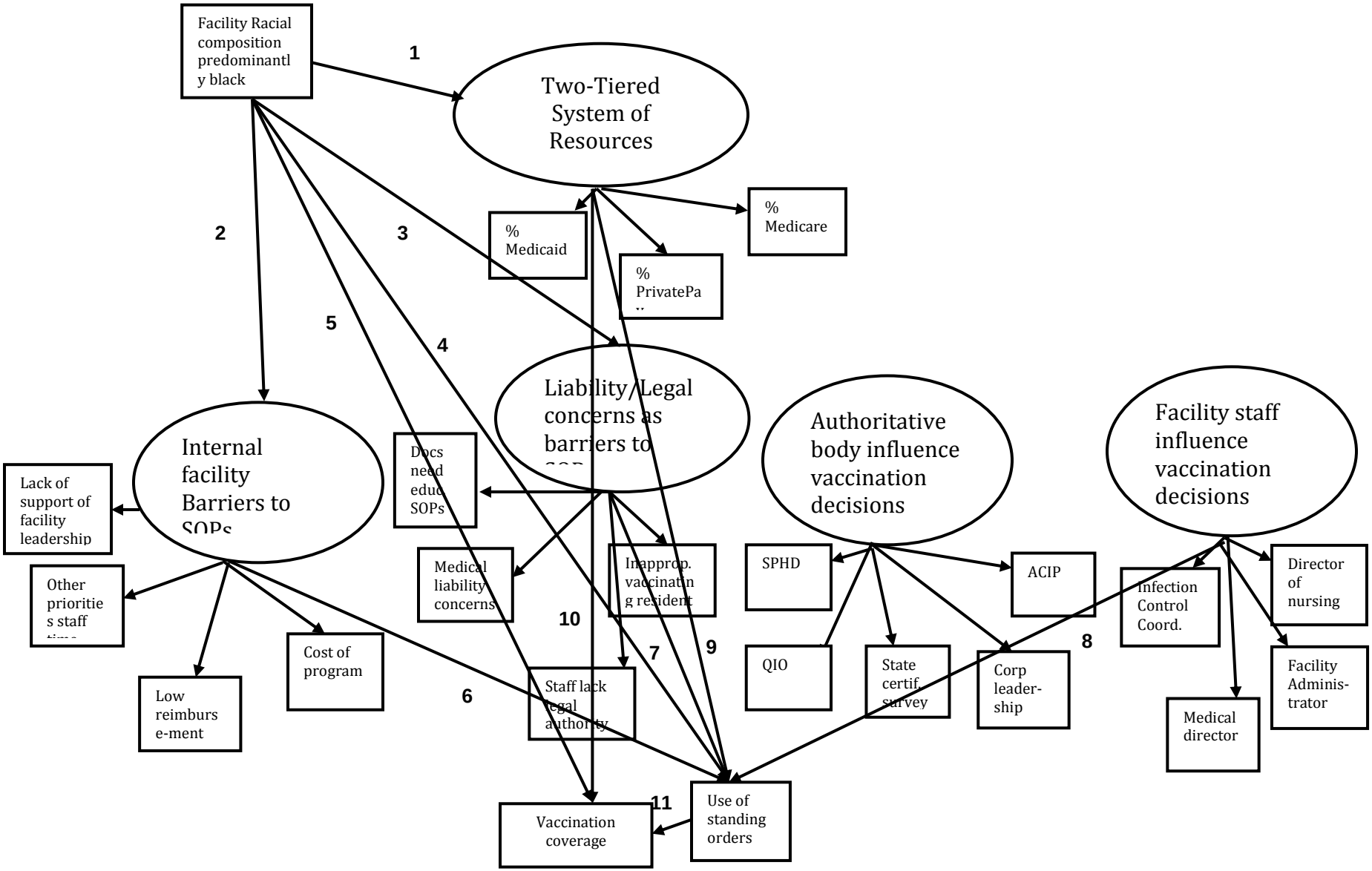


Figure 8-3. Measurement model: Barriers to implementing standing orders for vaccinations, influential authorities for vaccination policies and two-tiered system of resources

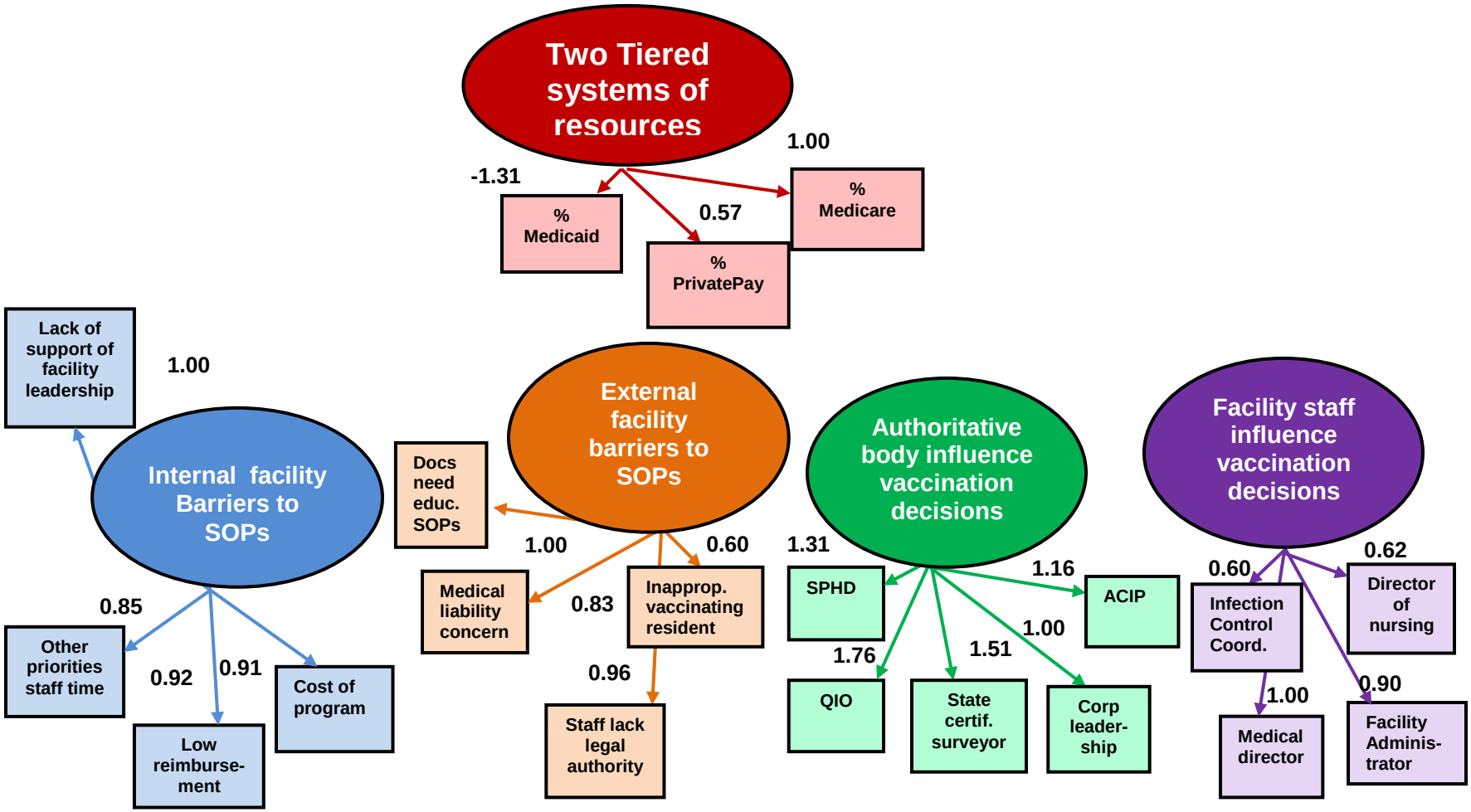
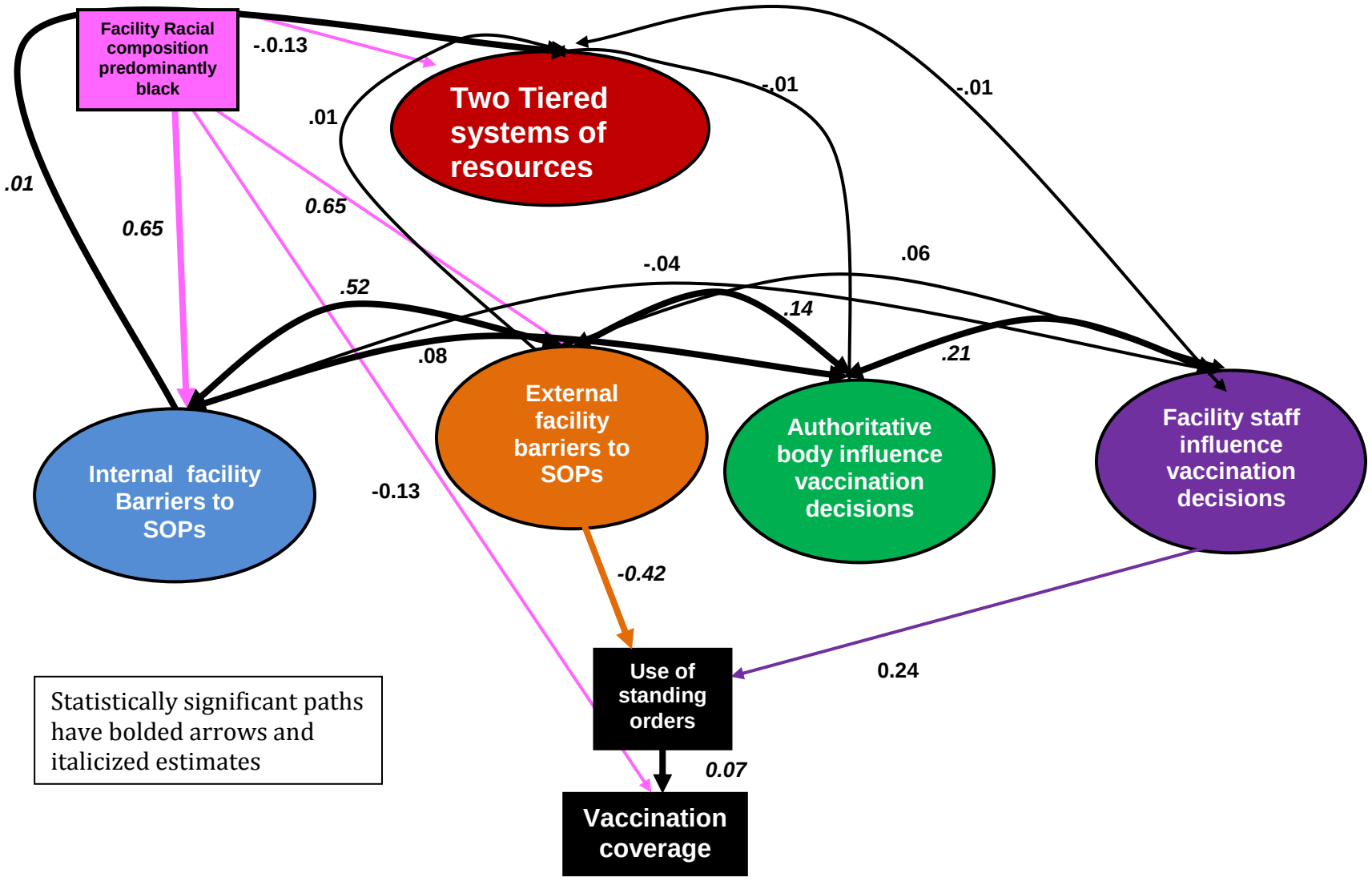


**Figure 8-4. Structural Model: Racial composition of the nursing home, barriers to implementing standing orders for vaccinations,
and influential authorities for vaccination policies jointly associated with use of SOPs and nursing home-level vaccination coverage**



CHAPTER 9 DISSERTATION IN CONTEXT: CONCLUSIONS AND PUBLIC HEALTH CONTRIBUTIONS

Conclusions

Our prior work established that racial inequities in influenza vaccination among nursing home residents were both between and within facilities in Michigan. The statewide W-B difference of over 20 percentage points was mostly attributable to between facility differences. We sought to find factors contributing to the differences both between and within facilities. Our prior work also found that use of standing orders protocols was associated both with higher vaccination coverage for both White and Black nursing home residents and with a narrow, non-significant White-Black difference in influenza vaccination. We sought to determine if racial composition of the facility, influential authorities in vaccination policy decisions and barriers to standing orders protocols jointly contribute to the racial gap in vaccination between nursing homes in a sample of 14 states.

Characteristics such as administrative factors, racial composition of the nursing home, case mix indicators, staff resources, and county level resources collectively estimated explain 36.9% of the variability in offering influenza vaccine among nursing facilities in Michigan. The proportion of Black residents in the facility accounted for the most variability in offering vaccine, 15.4%, followed by the ratio of the total number of FTEs in the facility to the number of residents during the influenza season, 15.2%. The percent of variability accounted for by facility and county characteristics varied among the 5 strata of nursing homes, from 20.1% among the homes with 0.1%-5% Blacks to 54.8% among the homes with 20%-

49.9% Blacks. No factor consistently contributed to variability between nursing homes in offering vaccine among the 5 strata of homes. The ratio of FTEs to residents contributed the most to variability in offering vaccine among the 4 strata of homes with <50% Blacks (range: 13.8% -26.3%). Based on the variables we measured in this population, we could not identify latent constructs that contribute to the variability in offering vaccine between homes. Rather, the differences in offering vaccine in Michigan may due to unmeasured factors such as the type of immunization program adopted by the facility, staff attitudes towards vaccination, and perhaps the racial composition of the staff in the racially mixed homes.

Within nursing facilities, we found that frailty was associated with the racial gap in vaccination in that frail residents of the minority race in the nursing home were less likely to be offered the vaccine. In nursing homes in which Blacks were in the majority (i.e., $\geq$ 50% Black residents), frail White residents had lower likelihoods of being offered the vaccine than frail Black or less frail White residents according to the CPS and ADL frailty scales. In the predominantly White homes (i.e., 0.1% - < 5% Black residents) frail Black residents were less likely to be offered the vaccine than frail White residents. The racial difference in offering the vaccine to frail residents according to the proportion Black residents in the nursing home may have to do with staff attitudes toward vaccination, particularly the race of the staff and their associated beliefs about race and vaccination near end of life. These findings are disconcerting and deserve further research.

Constructs for barriers to implementing standing order protocols, both internal and external to the facility, were identified. We also identified constructs for

authorities who are influential in making vaccination policy decisions. Our model suggests the state's QIO and the state certification surveyor may be in the best position to address misperceptions about staff's authority to vaccinate under SOPs and to educate physicians about the benefits of SOPs for influenza vaccination among nursing home residents. Also, facilities with larger proportions of Black residents had higher likelihoods of perceived barriers to implementing SOPs that were negatively associated with implementing SOPs; thus homes with larger proportions of Black residents should especially be targeted to address misperceptions.

Limitations

A limitation of all our studies is that the data are cross-sectional during the influenza vaccination season. Also, the vaccination status reported on the MDS has not been validated so we cannot determine the extent of possible bias using an evidence-based sensitivity analysis. Approximately 7% of residents were reported to be unvaccinated because they were not in the facility during the influenza season (between October 1 and March 31), yet their assessment dates (and types) indicate that they did live in the facility during that time. There was no racial difference in this misclassification (data not presented). Another limitation for two of the papers was that we examined only one state and therefore the data may not be generalizable to what drives racial variability in vaccine uptake in other states. Due to the great variability in vaccine offering levels between nursing homes as well as between states, we believed it was appropriate to examine the W-B differences within one state before combining states; an analysis combining states would have

to account for all state level factors and correlation due to the clustering effect of residents within nursing homes and nursing homes within states which is methodologically unmanageable (i.e., would necessitate over 30,000 parameters in the model to account for random effects) as well as being beyond the scope of our objectives. However, we have done preliminary analyses individually examining 10 other states with $\geq$ 9.6 percentage point racial gaps in vaccination during the same season and found similar trends in W-B offering differences *between* facilities, stratified by proportion of Black residents.

For the frailty analysis, the date of vaccination was unknown so we could not tie the health condition of the resident to the day of vaccination, per se. However, to be conservative, we used the record that would indicate the highest level of frailty.

For the paper examining barriers to implementing standing orders and influential authorities who make vaccination policy decision, a limitation of the study was the small ratio of "sample size to number of parameters" in the model. We may have failed to detect statistically significant paths in our best fitting structural model due to lack of power. However, because the statistically non-significant paths were theoretically sound and the model was a good fit, it is reasonable to assume those paths are important in the model overall; future research should investigate these paths. The 14 states included in this study may not be representative of other states and/or geographic regions and therefore the results may not be generalizable.

Public health contributions

The work that led to this dissertation as well as the work done for the dissertation has resulted in several contributions to research and improving influenza vaccination coverage among nursing home residents. Validation studies are now underway to assess the accuracy of vaccination status as recorded and reported in the MDS. Also, qualitative studies will be done to further understand the immunization processes within nursing homes. This information can be used to determine what can be done to improve the vaccination coverage for all facility residents and to narrow the racial gap in being offered the vaccine.

Specifically in Michigan, we are working with our partners in the state health department to assess the nursing homes with the lowest vaccination coverage and the largest W-B gaps in being offered the vaccine. Our work has brought the problem to light and steps are being taken to improve the inequities.

APPENDIX 1: Multilevel model examining race and vaccination
The multilevel model and null hypothesis for the random effects:
Level-1 Model

$$\text{Prob}(Y_{1ij}=1|\beta_j) = P_{1ij}$$
$$\text{Prob}(Y_{2ij}=1|\beta_j) = P_{2ij}$$
$$\text{Prob}(Y_{3ij}=1|\beta_j) = P_{3ij} = 1 - P_{1ij} - P_{2ij}$$

Where Y_1 is not offered the vaccine or contraindicated, Y_2 is refused the vaccine and Y_3 is received the influenza vaccine either in the current facility or outside the current facility of residence. Bold indicates the variable is uncentered. Resident level variables non bolded are centered around the group mean and Facility level variables are centered around the grand mean. Frailty score was categorized for each of CPS, CHESS, and the ADL scale.

$\log[P_{1ij}/(P_{3ij})] = \gamma_{101}$(facility level intercept) **+** γ_{201}*(Education$_{ij}$ – $\overline{\text{Education}}_{.j}$) + γ_{301}*(Medicaid$_{ij}$ – $\overline{\text{Medicaid}}_{.j}$) + γ_{401}*(Medicare$_{ij}$ – $\overline{\text{Medicare}}_{.j}$) + γ_{501}*(Sex$_{ij}$ – $\overline{\text{Sex}}_{.j}$) + **$\gamma_{601}$*(Black vs White$_{ij}$)** + γ_{701}*(Age$_{ij}$ – $\overline{\text{Age}}_{.j}$) + γ_{801}*(Private payment$_{ij}$ – $\overline{\text{PrivatePaymen}}_{.j}$) + γ_{901}*(Frailty score$_{ij}$ – $\overline{\text{Frailtyscore}}_{.j}$) + γ_{1001}*(Frailty score$_{ij}$ – $\overline{\text{FrailtyScore}}_{.j}$)***(Black vs White$_{ij}$)** + γ_{1101}*(total number of residents in the facility – $\overline{\text{totalnumberof residentsin thefacility}}$.) + γ_{1201}*(Percent Blacks in facility – $\overline{\text{PercentBlacks in facility}}$.) + γ_{1301}*(Chain$_j$ – $\overline{\text{Chain}}$.) + γ_{1401}*(Number RN FTES$_j$ – $\overline{\text{NumberRN FTES}}$.) + γ_{1501}*(Percent residents on Medicaid – $\overline{\text{Percentresidentson Medicaid}}$.) + γ_{1601}*(Ownership$_j$ – $\overline{\text{Ownership}}$.) + γ_{1701}*(Certification – $\overline{\text{Certificaton}}$.) + γ_{1801}*(In compliance with program requirements$_j$ – $\overline{\text{In compliancewith programrequirements}}$.) + γ_{1901}*(Percent on Medicare$_j$ – $\overline{\text{Percent on Medicare}}$.) + γ_{2001}*(Percent with príváte pay$_j$ – $\overline{\text{Percent withprivatepay}}$.)+ γ_{2101}*(Urban/rural$_j$ – $\overline{\text{Urban/rural}}$.) + u_{01j}

$\log[P_{2ij}/(P_{3ij})] = \gamma_{102}$(facility level intercept) **+** γ_{202}*(Education$_{ij}$ – $\overline{\text{Education}}_{.j}$) + γ_{302}*(Medicaid$_{ij}$ – $\overline{\text{Medicaid}}_{.j}$) + γ_{402}*(Medicare$_{ij}$ – $\overline{\text{Medicare}}_{.j}$) + γ_{502}*(Sex – $\overline{\text{Sex}}_{.j}$) + **$\gamma_{602}$*(Black vs White$_{ij}$)** + γ_{702}*(Age$_{ij}$ – $\overline{\text{Age}}_{.j}$) + γ_{802}*(Private payment$_{ij}$ – $\overline{\text{PrivatePaymen}}_{.j}$) + γ_{902}*(Frailty score$_{ij}$ – $\overline{\text{Frailtyscore}}_{.j}$) + γ_{1002}*(Frailty score$_{ij}$ – $\overline{\text{FrailtyScore}}_{.j}$)***(Black vs White$_{ij}$)** + γ_{1102}*(total number of residents in the facility – $\overline{\text{totalnumberof residentsin thefacility}}$.) + γ_{1202}*(Percent Blacks in facility – $\overline{\text{PercentBlacks in facility}}$.) + γ_{1302}*(Chain$_j$ – $\overline{\text{Chain}}$.) + γ_{1402}*(Number RN FTES$_j$ – $\overline{\text{NumberRN FTES}}$.) + γ_{1502}*(Percent residents on Medicaid –

$\overline{\text{Percent residents on Medicaid.}}) + \gamma_{1602}*(\text{Ownership}_j - \overline{\text{Ownership.}}) + \gamma_{1702}*(\text{Certification} - \overline{\text{Certification.}}) + \gamma_{1802}*(\text{In compliance with program requirements}_j - \overline{\text{In compliance with program requirements.}}) + \gamma_{1902}*(\text{Percent on Medicare}_j - \overline{\text{Percent on Medicare.}}) + \gamma_{2002}*(\text{Percent with private pay}_j - \overline{\text{Percent with private pay.}}) + \gamma_{2102}*(\text{Urban/rural}_j - \overline{\text{Urban/rural.}}) + u_{02j}$

where i=resident and j= nursing home, $u_{01j} \sim MVN(0, \sigma^2_{01})$ and $u_{02j} \sim MVN(0, \sigma^2_{02})$
$H_0: \sigma^2_{01} = 0$; $H_0: \sigma^2_{02} = 0$

Facility level variables are 'grand mean' centered (subscript '.') which makes zero equal to the proportion in the population without that characteristic instead of meaning no one in the population has that characteristic. Similarly, resident level variables are 'group mean' centered (subscript '.j') which makes zero equal to the proportion of residents in the nursing home without the characteristic instead of meaning no one in the facility has the characteristic. The certification and ownership variables were nominal with more than 2 categories and therefore dummy variables were used.

The estimates from the overall model [Table 6-3] are interpreted as 'probabilities in getting vaccinated overall in the population being studied.' Probabilities derived from this model are interpreted by comparing the 'average' Black and White residents in the 'average' nursing home in the population. The reason for this interpretation is that in a multilevel model with random effects, the facility lived in is held constant and the confounder variables are centered to 'hold them constant.' To do this, the level 1 confounders are centered around the facility mean and the level 2 confounders are centered around the population mean. That changes the meaning of zero from meaning the factor not present is the referent group to meaning the referent is the average proportion in the facility *without* that

factor (level 1) or the proportion in the population without that facility characteristic (level 2): thus the 'average resident' in the 'average facility'. The race terms were uncentered so that we could say specifically the odds for Black residents vs White residents, etc. The frailty terms were centered around the group mean; the meaning of 'one' for the frailty terms is the proportion in the nursing home *with* the frailty characteristic.

However, to be able to examine the estimates to answer our research question, 'does frailty narrow the racial gap *within* nursing homes?', it is necessary to calculate estimates at the facility level. Because of the random effects, the multilevel model allows this flexibility. Using the model above, we calculated the probability (from the odds) of Blacks and Whites, frail and nonfrail for each racially mixed nursing home in the population. [Tables 6-4a-6-4c] Facilities were stratified by proportion Blacks in the nursing home and the median facility probability for vaccinated, refused, and not offered was reported for each group.

APPENDIX 2: Multilevel factor analysis

TESTS OF MODEL FIT

Chi-Square Test of Model Fit

Value	99.450
Degrees of Freedom	25
P-Value	0.0000

CFI/TLI

CFI	0.997
TLI	0.993

Number of Free Parameters 52

RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.006

SRMR (Standardized Root Mean Square Residual)

Value for Within	0.000
Value for Between	0.050

BETWEEN LEVEL RESULTS

GEOMIN ROTATED LOADINGS

	Resident Characteristics	Staff resources	Facility case-mix
Resident level variables			
Quality of life	**0.400**	0.014	0.066
Accidents or falls	**-0.396**	-0.054	-0.096
Speech impairment	**0.524**	-0.173	0.367
Medicaid payment source	**0.885**	0.026	-0.119
Length of stay	**0.925**	-0.086	-0.004
Facility level variables			
Acuity Index	-0.076	-0.005	**0.711**

Nurse hours/patient per day	-0.007	**0.594**	-0.296
CNA hours/patient per day	0.127	**0.972**	0.015
Direct Care hours/patient/day	-0.004	**0.905**	-0.057
Average ADLs in facility	-0.209	0.024	**0.790**
Proportion bowel incontinence	0.008	-0.219	**0.708**

APPENDIX 3: Results of exploratory factor analysis:

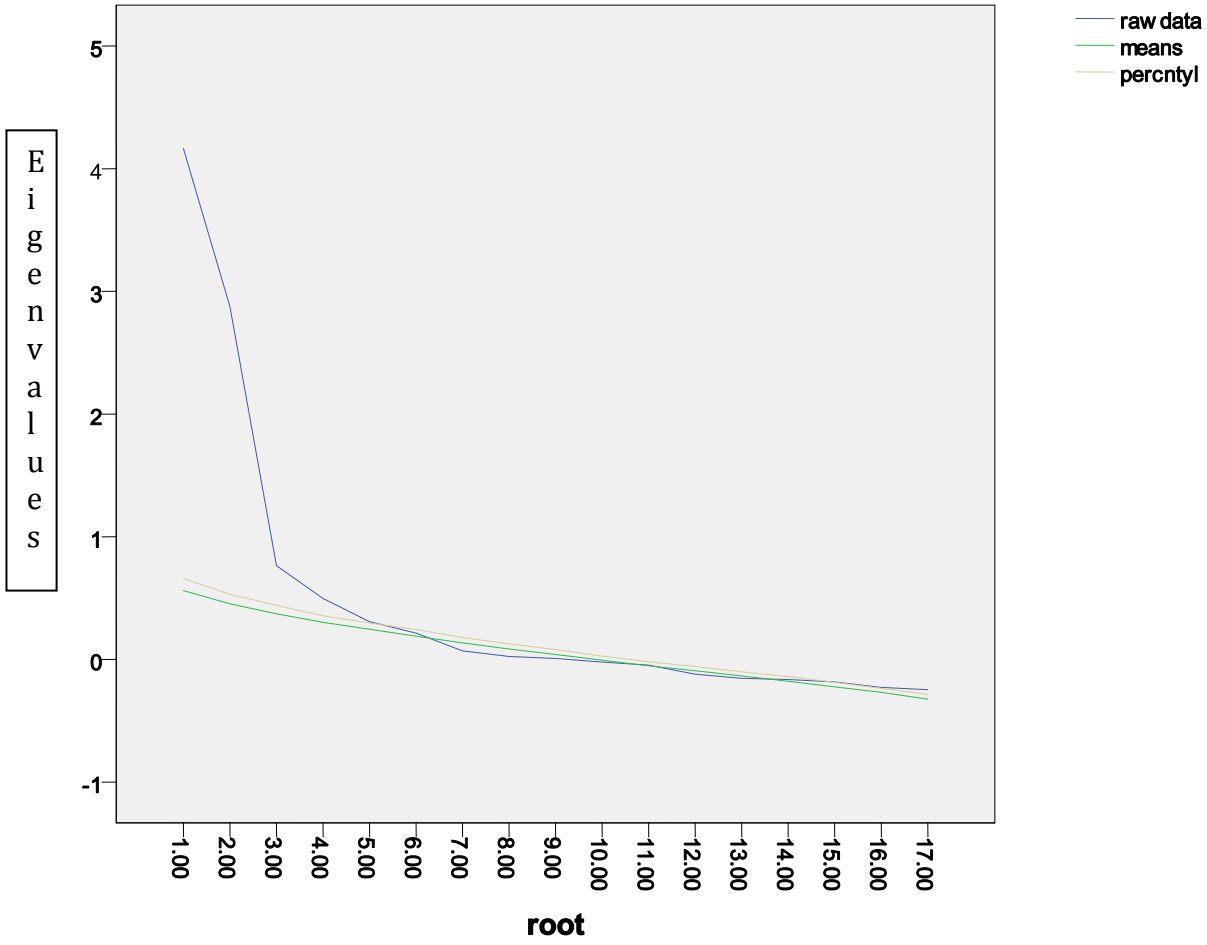
Two sets of questions regarding authorities influential in shaping vaccination decisions and barriers to implementing SOPs were assessed to determine the existence of latent constructs. Because we believed the questions were correlated, we grouped them together to determine how many factors or latent variables were present. Three different methods were used in order to determine how many factors to extract. Two approaches were performed using parallel analysis with SPSS. The first method included a comparison of eigenvalues from sample data to what would be expected from a random sample (imputations were run; Table A).

Table A. Common Factor Analysis & Random Normal Data Generation
Specifications for this Run:
Ncases 249
Nvars 17
Ndatsets 100
Percent 95

Root	Raw Data	Means	Prcntyle
1.000000	4.164562	.560201	.657853
2.000000	2.875188	.452242	.529697
3.000000	.763367	.371600	.440126
4.000000	.496230	.301922	.355159
5.000000	.306946	.245417	.296128
6.000000	.214017	.188752	.242946
7.000000	.068755	.134516	.177714
8.000000	.023911	.084357	.126866
9.000000	.007182	.040135	.079330
10.000000	-.022098	-.006668	.026685
11.000000	-.047376	-.052225	-.019914
12.000000	-.121882	-.093149	-.058602
13.000000	-.154801	-.135317	-.102507
14.000000	-.165179	-.178059	-.140382
15.000000	-.184457	-.223710	-.187593
16.000000	-.228554	-.268197	-.235801
17.000000	-.247695	-.324874	-.284742

Five of the eigenvalues expected from the random data fall below the observed eigenvalues. It suggested a five-factor solution is feasible. Second, a scree plot of the

sample data and expected values was assessed (see below).



The rate of decline tends to be fast for the first 2 factors but then begins to level off. The scree plot suggests a maximum of four factors. The third method was Kaiser's eigenvalue-greater-than-one rule, performed in MPlus (Table B).

RESULTS FOR EXPLORATORY FACTOR ANALYSIS

Table B. EIGENVALUES FOR SAMPLE CORRELATION MATRIX

1	2	3	4	5
4.732	3.442	1.964	1.260	1.055
6	7	8	9	10

0.896	0.852	0.828	0.675	0.606
11	12	13	14	15
0.588	0.513	0.483	0.383	0.369
16	17	18	19	20
0.324	0.299	0.276	0.255	0.200

Because the fifth factor is 1.055 or approximately 1, the eigenvalues suggest that 5 factors should be retained. A latent factor should have at least 4 observed values loading on it. However, the 2-tiered system was theoretically defined with the three variables, therefore we assessed 5 factors with the 20 variables models.

Assumptions

A basic assumption of measurement models (i.e., models with both latent factors and observed variables) is that the observed variables are conditionally independent given the latent variables. In other words, the dependence among observed variables is solely due to their common associated latent variables. Models with this assumption in exploratory factor analysis use orthogonal rotation (i.e., assumes observed variables are independent or uncorrelated). If there is reason to believe the observed variables are correlated with each other through their error terms or measurement error, then oblique rotation can be used. The variables in this analysis use likert scales (i.e., are ordinal) and therefore the distribution of these variables (see tables 8-1b and 8-1c) do not follow the normal distribution. Therefore, we used a maximum likelihood estimator robust to non-normality in which standard errors are computed with a sandwich estimator. Standard model fit statistics were used in assessing the final models or models with the 'best fit.'

Exploratory factor analysis models

Using the model fit statistics previously described, the final model included 5 latent factors with oblique rotation (correlation among observed variables).

EXPLORATORY FACTOR ANALYSIS WITH 5 FACTOR(S):
TESTS OF MODEL FIT
Chi-Square Test of Model Fit
Value 153.814
Degrees of Freedom 100
P-Value 0.0004
CFI
CFI 0.963
RMSEA (Root Mean Square Error Of Approximation)
Estimate 0.046
90 Percent C.I. 0.031 0.061
Probability RMSEA <= .05 0.642
SRMR (Standardized Root Mean Square Residual)
Value 0.030

Table B. Exploratory Factor Analysis: Standing Orders Immunization Project, 2000-2001

Loadings from the Exploratory Factor Analysis
Population means (n=249 nursing homes)

	Geomin Rotated Loadings				
Tiered System of Resources					
1 % Residents with Medicare	**-0.326**	-0.033	-0.110	0.183	-0.198
2 % Residents with Medicaid	**1.230**	0.012	0.001	-0.009	0.010
3 % Residents with Private Pay	**-0.597**	0.067	0.025	-0.100	0.080
Internal Barriers to SOPs (scale 1 to 5: 5=very significant barrier)					
4 Lack of support of facility leadership	-0.021	0.018	0.101	**0.391**	0.253
5 Cost program (e.g., retraining staff, admin time)	0.043	0.006	0.038	**0.901**	0.000
6 Low reimbursement .	0.001	-0.035	-0.009	**0.664**	0.133
7 Other priorities of staff time	-0.020	0.077	-0.183	**0.491**	0.265
External Facility Barriers to SOPs (scale 1 to 5: 5=very significant barrier)					
8 Need to educate physicians about SOPs	0.000	-0.106	0.062	0.256	**0.438**
9 Medical liability to the facility	0.013	0.033	-0.039	0.015	**0.841**
10 Inappropriately vaccinating resident	0.041	0.011	-0.034	0.019	**0.772**
11 Staff lack legal authority to immunize without physician order	-0.055	-0.056	0.076	0.064	**0.637**
Authoritative body influences vaccination policies (scale 1 to 5: 5=very important)					
12 Corporate Leadership	-0.001	0.228	0.237	-0.051	0.093
13 State Public Health Department (SPHD)	0.021	**0.677**	0.170	-0.042	0.032
14 State nursing home certification surveyors	-0.008	**0.765**	0.038	0.025	-0.026
15 Advisory Committee on Immunization Practices (ACIP)	-0.058	**0.472**	-0.014	-0.056	0.086
16 Quality Improvement Organization (QIO)	-0.008	**0.698**	-0.022	0.148	-0.116
LTCF staff influence vaccination policies (scale 1 to 5: 5=very important)					
17 Medical director	0.041	0.193	**0.547**	0.007	0.001
18 Infection Control Coordinator	-0.032	0.112	**0.584**	0.021	-0.025
19 Director of Nursing (DON)	-0.033	-0.037	**0.927**	0.007	-0.018
20 Facility administrator	0.060	0.262	**0.554**	0.012	0.064

The factor loadings are standardized estimates of the regression slopes for predicting the indicators from the latent factor, and thus are interpreted along the same lines as standardized regression. For example, the factor loading estimate for the ACIP was .472, which would be interpreted as a standardized score increase in the latent construct, authoritative outside bodies determining the facility's vaccination policy. Squaring the factor loadings provides the estimate of the amount of variance in the indicator accounted for by the latent variable (e.g., $.472^2 = 22.3\%$ variance explained). The amount of variance explained by the common factors (i.e., latent variables that are common to several variables in the model, but not to all variables in the model or entire pathway) is referred to as communality.[3] The remaining 77.7% is unique variance, which is a combination of variance specific to the indicator variable as well as its error variance.

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