THE EFFECTS OF HEALTHCARE SERVICE DISRUPTIONS ON THE COMMUNITY, HEALTHCARE SERVICES AND ACCESS TO CARE

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DEDICATION

"I can do all things through Christ who strengthens me." (*New King James Version*, Philippians 4:13)

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I believe the journey to a Ph.D. is a team endeavor. While the candidate needs to do the work, I believe the goal is best accomplished with the help of a community of supportive faculty, loving family and encouraging friends. That has certainly been the case for me.

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Carol Ann Mills

THE EFFECTS OF HEALTHCARE SERVICE DISRUPTIONS ON THE COMMUNITY, HEALTHCARE SERVICES AND ACCESS TO CARE

Access to healthcare services is important for improving health outcomes, preventing and managing illness, and achieving health equity. The geographic maldistribution of physicians has a negative impact on rural areas compared to urban, particularly as it relates to access to healthcare. Rural hospitals have been closing or converting to another form of healthcare service at an increasing rate, adding another element to the existing complexities in rural access to care. Although a hospital closure in any location may have a considerable impact on the community, the closure of a rural hospital may have disproportionately more substantial implications for the economy and employment, health outcomes, and access to care. The contributing factors preceding rural hospital closures have been studied, but less is known about the full impact of rural hospital closures on the community. There is some evidence of shortages in healthcare providers and services, and therefore communities may employ multiple strategies to mitigate the shortages and provide services, including utilizing telehealth/virtual services.

This dissertation proposes to examine the effects of rural hospital closures on the community, healthcare services, access to care, and provide a qualitative assessment of telehealth as a strategy to bridge gaps in provider access. This dissertation includes three studies: 1) a systematic review of the literature to examine the impact of rural hospital closures on the community; 2) an empirical study that utilizes a generalized difference in difference design with county and year fixed effects to estimate the relationship between

rural hospital closures and nursing homes; and 3) a qualitative study exploring the perceptions and experiences of the nurses that piloted a virtual care support project, providing insights into crucial elements important to the implementation of similar models and the role of telehealth in bridging healthcare workforce gaps.

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CHAPTER ONE

INTRODUCTION

Introduction

Access to healthcare services is important for improving health outcomes, preventing and managing illness, and achieving health equity.[1] The "Healthy People" initiatives by the Office of Disease Prevention and Health Promotion have identified access as one of the top objectives in the last three decades for improving health in America.[2-4] Access to quality healthcare is not only a priority for Americans overall, but has also been identified as a specific priority for rural areas. All four national U.S. Census Bureau regions (Northeast, South, West, Midwest), as well as rural hospitals, agencies, public health departments and clinics, reported that access to quality health services is their number one rural health priority of the 15 focus areas of the Healthy People 2010 initiative.[2, 5] An adequate supply of healthcare providers and services is an important element for access to healthcare.[3, 6] Other components include the ability to gain entry into the healthcare system, which typically means having health insurance coverage, and the ability to receive needed services when they are needed.[1, 6] Barriers to access include personal factors such as culture, language and income; financial barriers such as income and health insurance; and structural barriers including the availability of healthcare providers and transportation.[1-3] Access to care not only affects the physical and mental health status of individuals, but also the overall quality of life.[3] Access barriers can result in delayed or missed care, which may lead to unfavorable health outcomes.[1]

Access to healthcare may be particularly challenging for those residing in rural geographies, as geographic maldistribution of physicians negatively impacts rural areas.

Fewer than 12% of physicians choose to practice in non-metropolitan locations, despite approximately 20% of the population residing there.[7, 8] Although the density of primary care physicians increased nationally overall from 2009 to 2017, the gap in density between urban and rural counties is widening, with rural counties lagging behind.[9] An increase in rural hospital closures adds another element to the existing complexities in rural access to care. Rural hospitals have been closing or converting to another form of healthcare service at an increasing rate.[10, 11] Of the 180 rural hospitals that closed or converted since 2005, 35.6% of the closures occurred in the last 5 years.[10] Currently, approximately 9.6% of the US rural population lives in a county with no acute care hospital.[12]

Healthcare service disruptions can take many forms, and can have a significant downstream impact on the community. The downstream impact can affect health outcomes, access to care, and the health of the economy. One major healthcare disruption is the closure of a hospital. Rural hospital closures have been a concern for decades. The creation of Medicare's prospective payment system disrupted the hospital landscape during the 1980s, contributing to many hospital closures.[11, 13] Consequently, the federal government initiated several programs that provided additional reimbursement for hospitals that met certain criteria, such as the critical access hospital (CAH) designation, the disproportionate share (DSH) designation, and the sole community hospital (SCH) designation. The Medicare Payment Advisory Committee (MedPAC) reported in 2007 that between 1998 and 2005, more than 1,200 rural hospitals converted to critical access hospitals, and were no longer reimbursed under the prospective payment system.[14] For a brief time, rural hospital financial performance improved, but that improvement was

short-lived, and within a few years rural hospitals began to close again, and that trend continues today.[10, 14]

Any unfavorable finding related to access to care is particularly important in rural areas, as rural populations tend to lag behind non-rural populations in terms of health outcomes.[15] Rural populations tend to have higher rates of opioid misuse, smoking, obesity, and tend to be older and of lower socioeconomic status than urban populations.[16-20] Further complicating the rural healthcare system is that when rural hospitals close, physicians tend to also leave the community.[21, 22] Additionally, hospitals are often one of the larger employers in the community, and can have a significant impact on the local and regional economy.[23] Although the contributing factors of rural hospital closures have been studied, the factors can be complicated and may include poor financial performance, decreased utilization and unfavorable market position.[11, 24] Less is known about the full impact of rural hospital closures on the community.

When rural communities experience healthcare service disruptions, regardless of the type of disruption, communities and healthcare systems might employ multiple strategies to mitigate the shortages, or create alternative strategies to provide the services, in order to prevent diminished access to care. For example, in the case of a physician shortage or a reduction of another healthcare service, one strategy is to recruit more providers to the community. Only 5% of physicians choosing a primary care specialty also choose to practice in rural settings, creating a scenario that is not likely to quickly resolve.[25] In addition to trying to recruit more physicians and other providers to the rural community, the community may try to recruit alternative providers, such as nurse practitioners and physicians assistants, or other providers. An alternative care model may

mitigate the effects of a physician or service shortage. Another strategy may be to utilize telehealth/virtual services to provide care.[22] Electronic access to care may provide an option for communities experiencing gaps in provider availability.[26] Recent relaxation of some regulations related to telehealth, as well as the need for decreased person-to-person contact during the COVID-19 pandemic, have contributed to the growth of telemedicine.[27]

Overview of dissertation

This dissertation proposes to examine the effects of rural hospital closures on the community, healthcare services, and access to care, and provide a qualitative assessment of telehealth as a strategy to bridge gaps in provider access. Study 1 is a systematic review of the literature to identify the impact of rural hospital closures on the community. Study 2 utilizes rural hospital closure data as well as nursing home data, to examine the relationship between rural hospital closure and nursing homes. Rural nursing homes may be negatively impacted by hospital closures in their communities, making it difficult to continue providing services, creating another geographic disparity for residents in rural counties. Study 3 explores the perceptions of nurses working in a virtual pilot project regarding the facilitators, barriers and effectiveness of the project.

Study 1 consists of a systematic review of the literature to examine the impact of rural hospital closures on the community. Rural hospital closures can leave a lasting impact on the communities they previously served. Although a hospital closure in any location may have a considerable impact on the community, the closure of a rural hospital may have disproportionately more substantial implications for the economy and employment, health outcomes, and access to care within the community. Although the

factors contributing to rural hospital closures have been studied, less is known about the full impact of rural hospital closures on the community.

Study 2 uses a generalized difference in difference design with county and year fixed effects, to estimate the relationship between rural hospital closures and nursing homes. Rural hospital closure data from the Cecil G. Sheps Center for Health Services Research at the University of North Carolina Chapel Hill from 2005 to 2018 will be used for analysis, as well as nursing home data from LTCFocus, a publicly available dataset from Brown University Center for Gerontology and Healthcare Research. Outcomes of interest include the effects of rural hospital closures on the number of nursing home facilities and nursing home beds. This study fills gaps of previous studies that examined the effect of rural hospital closures on the availability of healthcare providers and services, by measuring the relationship between rural hospital closures and the volume and capacity of nursing homes in the county. If the closure of rural hospitals negatively impacts nursing homes in the community, this may create yet another access to care challenge for rural communities.

Study 3 is a qualitative analysis of the perceptions of the nurses working in the Optimizing Patient Transfers, Impacting Medical Quality, and Improving Symptoms: Transforming Institutional Care (OPTIMISTIC) project during the implementation of a virtual pilot. The OPTIMISTIC project was part of a multi-site Centers for Medicare & Medicaid Services demonstration project focused on enhancing the care delivered in nursing homes and reducing avoidable hospitalizations of nursing home residents. Services for this program were previously delivered in-person by embedded registered nurses, until a virtual pilot was created to expand the reach of the program's services. The

purpose of this study is to understand the facilitators, barriers and perceived effectiveness of the virtual pilot of the OPTIMISTIC program, from the perspective of the nurses delivering the services. This study may provide insights into the elements that are important to the successful implementation of a virtual care management program, and may contribute to the understanding of the role of telehealth in bridging gaps in the healthcare workforce.

Given the trends of rural hospital closures in rural communities, this dissertation will provide a better understanding of the downstream effects of rural hospital closures on the communities they serve and the availability of healthcare services, and provide evidence that can guide and support decision-making related to hospital closures. Furthermore, this dissertation may provide additional insight into the use of virtual care delivery as a means of increasing access to care.

CHAPTER TWO

THE IMPACT OF RURAL GENERAL HOSPITAL CLOSURES ON COMMUNITIES-A SYSTEMATIC REVIEW OF THE LITERATURE

Introduction

Rural hospitals have been closing at an increasing rate over the past two decades and this has a substantial impact on the community.[10, 11] There are multiple ways to define and measure rurality, which may be based on geographical patterns like zip codes and counties, and eleven different methodological approaches.[28] This inconsistency makes it difficult to generalize findings about rural populations, and impacts the discussion of rural hospital closures. Although rural hospital closures have been increasing, it is not a new concern. The creation of Medicare's prospective payment system disrupted the hospital landscape during the 1980s, contributing to many hospital closures.[11, 13] Consequently, the federal government initiated several programs that provided additional reimbursement for hospitals that met certain criteria, such as the critical access hospital (CAH) designation, the disproportionate share (DSH) designation, and the sole community hospital (SCH) designation. For a brief time rural hospital financial performance improved and closures slowed, but that improvement was short-lived and within a few years rural hospitals began to close again; that trend continues today.[10, 14] From 2005 through 2021, 180 rural hospitals in the U.S. closed or ceased operations as an acute care hospital.[10] The risk factors associated with these closures include unfavorable financial performance, hospital payor mix, market factors, ownership, decreased rural population, and lower outpatient patient volumes.[11, 20, 24] Consequently, by 2017 9.6% of the rural population, over 4 million people, lived in a

county with no acute care hospital—often leaving them without a place to receive care near their home.[12]

Losing a community hospital may be especially detrimental to rural residents, who are vulnerable due to being older, lower socioeconomic status, more likely to smoke, be overweight/obese, and misuse opioids compared to urban residents.[19, 20] Rural hospital closures are known to decrease the local physician workforce, reduce types of services provided, contribute to unfavorable patient outcomes, and decrease access to care via increased travel times.[12, 15, 18, 21, 29-34] The downstream consequences may not only affect these outcomes related to access to care, but can affect the economy of the overall community.[23, 29, 35] In addition to providing healthcare services, hospitals are also often one of the largest employers in the community, and the loss of jobs has a significant impact on the local and regional economy.[23, 30, 36-38]

The purpose of this study was to compile the literature on the effects of rural hospital closures on the community and summarize the evidence, specifically the health and economic impacts, and identify gaps for future research. We hypothesized that studies would reveal that rural hospital closures are associated with unfavorable health outcomes, decreased access to care, and unfavorable economic indicators such as employment and local government revenue. Policymakers and hospital decision-makers need to understand the full range of ramifications of rural hospital closures on the community in order to mitigate the effects on the community, or take steps to prevent closures.

Methods

We conducted a systematic review of the peer-reviewed and "gray" literature, published from January 1, 2005, through December 31, 2021. This timeframe was selected to capture the published literature that reflects the current healthcare climate. The definition of gray literature that informs this systematic review is "print or electronic literature that is produced by government, academia, business, and industry, and is not controlled by commercial publishers".[39] The standards of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) Statement guided the data extraction, analysis, and reporting of this systematic review.[40] This systematic review of the literature does not involve human subjects, and meets the requirements for Exempt Research at Indiana University.[41] This systematic review has been registered at the International Prospective Register of Systematic Reviews (PROSPERO) (registration #: CRD42022314155).[42]

Databases and search strategy

We conducted a systematic review of the relevant literature, published in the following databases: EMBASE, CINAHL, PubMed, EconLit, and Business Source Complete. Databases from multiple disciplines were chosen to identify a wide range of literature related to the effects of rural hospital closures. We consulted a health services librarian to identify search terms and strategies. Database search terms included: "medically underserved area," "rural population," "rural nursing," "rural health services," "rural health," "hospitals," "rural," "health facility," "closing," and "closure." Additionally, for gray literature we searched documents from the United States (US) Government Accountability Office (GAO), and the Rural Health Research Centers

(RHRC) funded by the Federal Office of Rural Health Policy (FORHP), utilizing key search terms including "hospital" and "closure." These organizations conduct research that informs decisions by US government agencies, and may not always be published in peer-reviewed journals, but may contain timely and relevant information.

Inclusion and exclusion criteria

We included studies from peer-reviewed literature if they were empirical, published in the English language, included an abstract, and were conducted in the United States. A closed hospital is defined as a general, short-term, acute care hospital that no longer provides acute inpatient or any other healthcare services. This definition does not include hospitals that changed ownership but continued to provide inpatient services, or hospitals that opened and closed in the same calendar year and in the same location.[43] Included studies contained general acute care closures as an independent variable. All studies involved rural populations, either defined as inclusion criteria, covariate, or stratifying variable. Dependent variables were consistent with health services research measures for access, quality, and cost of healthcare services and health outcomes, as well as economic measures including employment and income.[44] We included documents from the GAO and RHRC that focused on rural hospital closures, which were published in the English language, conducted in the United States, and focused on similar outcomes as the peer-reviewed literature. We excluded papers if the focus was on the closure of individual service lines within hospitals, or involved the closure of a specialty hospital.

Screening

Two authors (CM and JB) conducted an initial screening of titles and abstracts, applying inclusion and exclusion criteria. The same two authors conducted a screening of full texts for inclusion. Any disagreements were settled by consensus through discussion by the reviewers. We also conducted a forward and backward snowball search of the reference lists of included papers, to identify additional relevant studies, agreed upon by consensus. Screening and analysis were completed using Covidence software (Covidence, Melbourne, Australia).

Analyses

We extracted the following data from each paper: study design, publication year, lead author, state/region studied, journal, organization/source, definition of rural used by the study, type(s) of outcome analyzed, period of study, and key findings. We computed descriptive statistics (frequencies) of study attributes (Table 1), and synthesized primary study findings by type of outcome (Figure 1). The unit of analysis was the outcome attributed to closure, such that a single included paper could have multiple outcomes. Study outcomes were assigned a code, improved/favorable/desirable, worsened/unfavorable/undesirable, or null. We assumed directionality to be worsened/unfavorable/undesirable if it indicated a barrier to access or represented a generally negative societal perspective. We assumed directionality to be improved/favorable/desirable if it indicated a facilitator to access or represented a generally positive societal perspective. We assigned a code of null if the outcome indicated no significant change. We coded increases in mortality and increases in length

of stay as worsened/unfavorable/undesirable, although both categories of outcomes can be viewed differently under different circumstances.

Results

The 2020 PRISMA diagram includes two parallel processes; one is the traditional process for studies identified via databases and registers, and the other is for identification of studies via other methods, including gray literature, and citation/snowball searching.[40] Following the first process of database searches, our database searches of peer-reviewed literature identified 219 papers for review, published between the years 2005-2021. Following removal of duplicates and applying inclusion criteria in title, abstract and full-text screening, eight articles remained. Following the second search process of other methods, our searches of gray literature identified 12 papers for review, plus eight papers identified through forward and backward snowball searches of the reference lists of included articles. Following removal of duplicates and applying inclusion criteria in title, abstract and full-text screening of articles found using methods other than database searches of peer-reviewed literature, 13 articles remained (see Figure 2 PRISMA flow diagram). A total of 21 articles were identified for inclusion in this study. CM completed data extraction on all included studies. JB completed a random review of extracted studies. A summary of the included studies in this systematic review can be found in Table 2.

Of the 21 studies included in this study, more than half (57.1%) were found in the gray literature, and employed quasi-experimental research designs (57.1%). Eighty-one percent of the studies utilized national data. Economic research organizations and rural health research centers produced a combined 38.1% of the studies, followed by peer-

reviewed journals focused on clinical, health policy, and health research topics (each 14.3%). Of note, 71.5% of the studies were published between 2018-2021. The studies used multiple definitions of rural to define rural hospital closures, however the most commonly used taxonomy was rural-urban commuting area (RUCA) codes (42.9%), which incorporate census tract and commuting data.[45] Generally, rural areas defined by RUCA methodology are non-urban areas of fewer than 50,000 people.

Although the types of outcomes examined varied greatly, they fit broad topical categories for analysis and description: economic, employment, transportation to care-emergency, access to providers/services, provider supply, quality of care, and transportation to care-general. Furthermore, studies frequently consider multiple outcomes which spanned across topics. Nine studies included economic outcomes, followed by employment (n=7), transportation to care-emergency (n=5), access to providers/services (n=4), provider supply (n=4), quality of care (n=4), and transportation to care-general (n=4). A summary of the outcomes in each study can be found in Figure 1, with an indication of the direction of the outcome as generally improved/favorable/desirable, worsened/unfavorable/undesirable, or null.

Economic Outcomes

Economic outcomes were the most commonly studied category and include measures that impact community or personal economic wellbeing. Overall, 89% of the studies that examined the economic outcomes of rural hospital closures found unfavorable outcomes, including decreased income, population, and community economic growth, and increased poverty.[22, 23, 30, 46-51] The most commonly studied outcomes were income and population, both of which decreased in five of six studies,[22,

[23, 48-50] although one study observed increases in both.[46] Decreases in per capital income ranged from 2.7% to 4% following rural hospital closure.[23, 50] Other economic outcomes considered in more than one study include community economic growth, poverty, rent, and tax revenue, with all finding unfavorable results.[22, 30, 48-51]

Employment

Employment outcomes were examined by seven studies, with nearly all unfavorable results. Employment and unemployment rates were found to have unfavorable outcomes by all seven studies, particularly if the closed hospital is the sole hospital in the community.[22, 23, 30, 48-51] Unemployment rates increased by 1.6% to 3.1% following rural hospital closures.[23, 49, 50] In addition to decreases in healthcare employment, rural hospital closures were found to lead to unemployment spillover into non-healthcare sectors, as well, resulting in decreases in non-hospital employment including information, scientific, construction, education, and real estate; and certain jobs, including management, natural resources, arts, and maintenance.[49, 50]

Transportation to care – emergency

Five studies examined outcomes related to emergency transportation, and the time required to respond to emergencies and transport patients to care.[22, 31, 52-54] Although there was no change found in the mean emergency response time or the time spent at the scene following a rural hospital closure,[31, 52] the time required to transport patients to the nearest emergency facility increased, as did the transport miles.[52, 53] Following rural hospital closure, an average 11-15.7 additional minutes were required to transport patients to the nearest emergency facility.[52, 53]

Access to providers/services

In the four studies that examined access to providers or service providers, the researchers found diminished access to medical specialists and hospital services.[22, 29, 48, 55] The most frequently studied outcomes related to provider access included access to lab, radiology, diagnostic services, emergency services, obstetric care, and federally qualified health centers (FQHC), of which only FQHC access was found to be favorable post-hospital closure.[22, 55] FQHC's are ambulatory care centers that provide primary care to areas designated as a health professional shortage area (HPSA).[56] The probability of having an FQHC within 10 miles of a community following rural hospital closure increased each year post-closure by 5.95% to 11.57%, however no similar change was seen in rural health clinics (RHC).[55]

Provider supply

Four studies examined provider supply following rural hospital closure, including physicians and advance practice providers such as nurse practitioners (NP), certified nurse anesthetists (CRNA), and physician assistants (PA).[21, 22, 33, 57] Overall, when rural hospitals close, the community experiences an average annual decrease in physician supply, particularly following the closure of a sole hospital in a county.[21, 22] The two studies that examined primary care and specialist physician supply both found a decline in primary care physicians, but only one found a corresponding decline in specialty physicians, as well.[21, 57] The percentage decrease in provider supply varies by provider type, with an estimated 8.3% decrease in primary care physicians.[21] Two studies examined advanced practitioner supply following rural hospital closure; one study found favorable outcomes and the other found no significant change.[33, 57]

Quality of Care

All four of the studies that examined a type of quality-related outcome examined a mortality outcome, two of them exclusively mortality, with a wide variety of measures and mixed results.[32, 47, 51, 58] Overall, three of the four studies found unfavorable or no significant change in the mortality measures, however two studies found some favorable outcomes on other measures of quality.[47, 58] One study found unfavorable urban mortality outcomes, as a result of rural hospital closures.[32] Inpatient length of stay was examined by two studies; one study found increased length of stay and the other found no significant change in length of stay.[32, 47]

Transportation to care – general

The four studies that examined non-emergent transportation to care found consistently unfavorable outcomes related to time, distance, and availability of transportation.[22, 48, 59, 60] Of the services most commonly previously offered by the closed hospitals, the average increase in distance to obtain those services post-hospital closure was approximately 20 miles.[59]

Discussion

The main findings of this systematic review can be summarized as 1) the topic is not extensively researched, and extant research is predominantly recent, with 71.5% of the studies published between 2018-2021, 2) most studies found negative economic outcomes, and 3) access to care is negatively impacted as travel times to services increase.

We found that over 90% of the included studies in both peer-reviewed and gray literature were published in the last eight years, and nearly three-fourths were published

in the last four years. Only 21 studies met inclusion criteria despite no criteria restrictions in the type of impact or outcome included in the study. Although more research has been published in recent years, there is still a relative dearth of literature published on this topic. Prior research on the topic of rural hospital closures has tended to focus on the causes and precursors of closures, which may help to predict, prevent or delay closures. More recent research has started to focus on the effects of rural hospital closures, perhaps due to the increasing rate of closures in recent years. Rural Health Research Centers and economic research organizations are the sources of much of the gray literature in this systematic review. The studies in this systematic review that are from the gray literature are similar in study design to the studies published in peer-review journals. More than half (57%) of the total studies employed a quasi-experimental design.

In terms of types of outcomes studied, most (76.2%) of the studies examined economic/employment-related outcomes, followed by emergent and non-emergent transportation (42.8%), access to and supply of healthcare providers (38%), and quality of patient outcomes (19%). However, within categories, the measures of economic outcome, quality of care, and rural status varied across studies, making it difficult to compare results and draw general conclusions. Reproducibility of results is necessary to strengthen the conclusions about many of the outcomes considered in the literature, which have been sparsely investigated. A similar lack of consistency is seen in the variety of definitions of rural used in the included studies, with RUCA being the most common (42.9%). The consequences of lacking a consistent definition of rurality have been previously noted in other contexts.[28, 61, 62] Given how the Centers for Medicare and Medicaid Services define rural hospitals with the Medicare Rural Hospital Flexibility

Program including the designation of Critical Access Hospitals, what it means to be a "rural hospital" is difficult to define. In addition to the need for more studies of the effects of rural hospital closures, investigators should strive for greater consistency in the definitions of rurality used, to increase comparability of study outcomes and create more meaningful analyses to inform policy decisions.

Not surprisingly, when rural hospitals close, rural residents need to travel further to receive hospital-based services, in both emergent and non-emergent situations. This is particularly true when the sole hospital in a county closes and may be related to reductions in the healthcare workforce, which was observed in seven studies in our review. Although there was no change found in the time required for emergency transport to arrive at the scene, additional time and distance are required to transport patients to an acute care hospital following rural hospital closure. This additional total transport time and distance may create a strain on limited emergency resources, and may pose challenges to the long-term viability of emergency transport services. While only 23% of rural hospitals support emergency medical services (EMS) in their communities, if a hospital that does support local EMS closes, the community could potentially also lose its EMS provider.[63] A possible cascading effect of a rural hospital closure is the reduction in the healthcare workforce, followed by increased travel time to services, which may result in worse health outcomes. However, the least amount of research has considered quality of care measures, including direct health outcomes. Since the majority of studies that did assess quality outcomes focused on mortality, there is a gap in the collective understanding of how rural hospital closures affect the short- and long-term health of

communities. Given the vulnerable health status of many rural residents, it is important to evaluate the impact on health outcomes beyond mortality, when rural hospitals close.

Studies found rural communities were adversely affected by hospital closures across most outcome measures considered, except for improved access to FQHCs and increased supply of advance practice providers. These are important findings in the context of the availability of primary care services. However, given the services provided at FQHCs, these providers are not a substitute for services provided by an acute care hospital. Understanding how this shift in service availability affects health outcomes warrants future investigation.

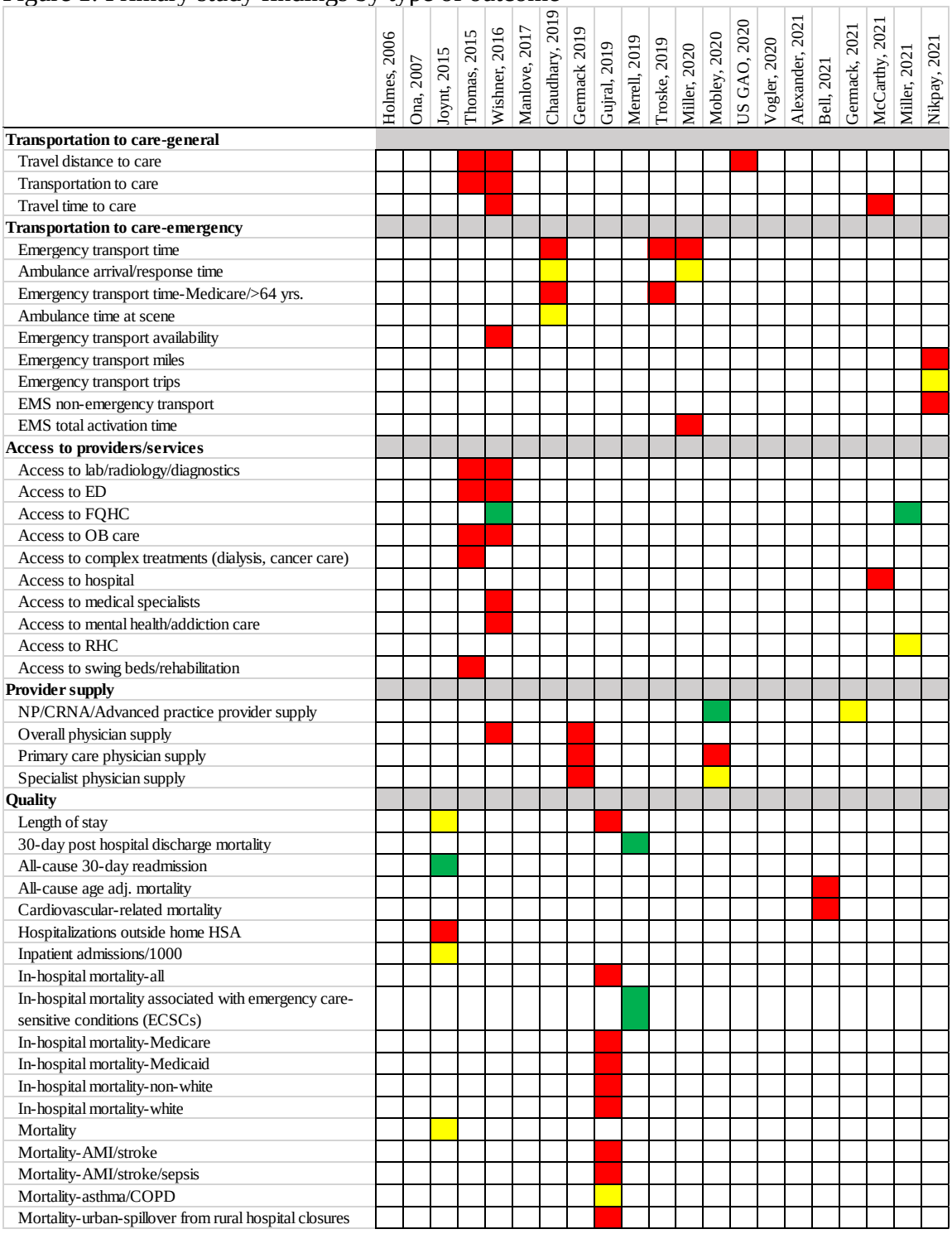
Despite our systematic approach, and working with a health services librarian to develop our search terms and strategy, there is potential to have missed some relevant articles. We included gray literature and conducted forward and backward snowball searches to minimize that possibility.

Conclusion

The impact of rural hospital closures on the community has not been well-studied, particularly in the peer-reviewed literature. Because of the predominantly negative economic outcomes resulting from rural hospital closures, policymakers and community leaders can better foresee these outcomes when anticipating a hospital closure, and work to mitigate the effects. Future researchers are encouraged to increase consistency in outcome measures, variables, and definitions in this area. As a result of the increased time and distance required to access healthcare services post-hospital closure, rural residents may experience access-related changes in health outcomes. Therefore, in addition to increasing the number of studies, future work in this area might expand in

scope to include measures common to health services research beyond mortality, including other quality measures, cost of healthcare services, and health outcomes. Additional research in the area of healthcare services and workforce would help to better characterize the downstream impact of rural hospital closures on services such as rehabilitation, mental health services, long-term care, and non-physician healthcare providers. Failure to conduct this focused research to better understand this phenomenon, could result in investment in programs and incentives that do not address the core issues and that do not mitigate the actual outcomes of rural hospital closures, which could lead to continued or more significant unfavorable health and financial outcomes. This study provides an initial summary of the effects of rural hospital closures on communities; however, additional research is needed to better understand this complex issue.

Figure 1: Primary study findings by type of outcome



Employment	
Employment	
Unemployment	
Employment-spillover into other sectors	
Employment-healthcare	
Employment-non-healthcare	
Employment-private sector	
Labor force participation	
Economic	
Income (per capita, personal income growth rate)	
Population	
Community economic growth	
Poverty	
Rents (overall, median)	
Tax revenue	
Ave. credit score	
Balance past due	
Bankruptcies	
Collections	
Credit worthiness	
Health services share	
Home loans	
Household welfare	
Landowner welfare	
Recruiting new employers/industries	
Risk-adj IP costs/beneficiary	
Working at home	

Note: Green = improved, favorable, desirable; Red = worsened, unfavorable, undesirable; Yellow = null

Figure 2: PRISMA flow diagram

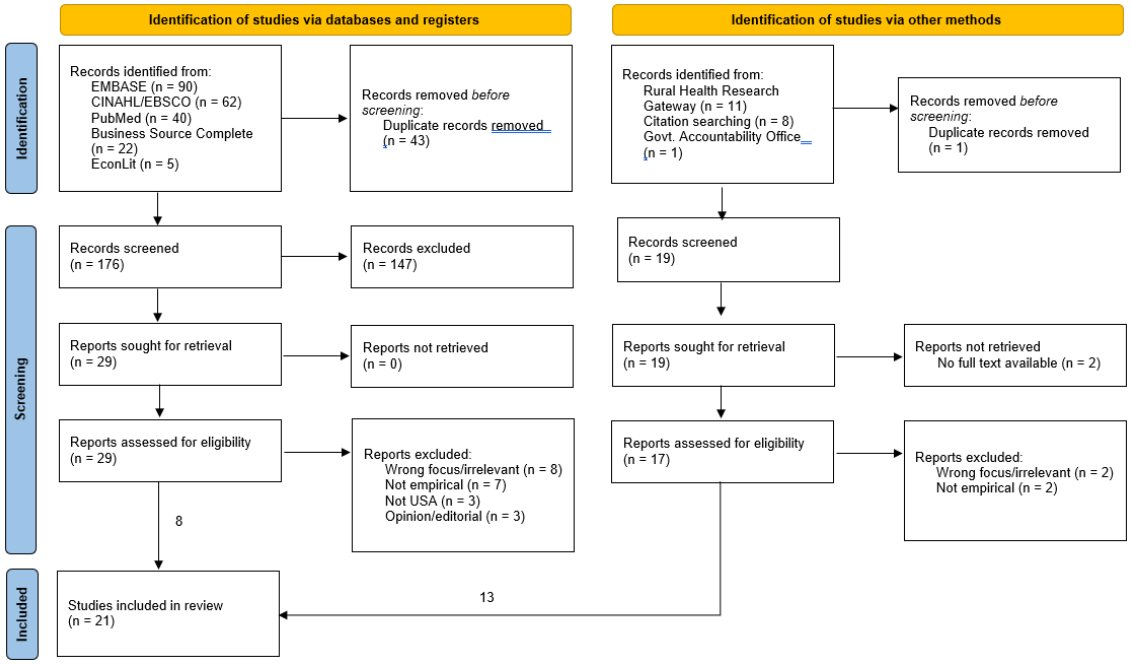


Table 1: Description of study attributes (n = 21 studies)

Study Characteristics	Number	Percentage
Gray	12	57.1
Peer-reviewed	9	42.9
Journals and organizations		
Economic research organizations	4	19.0
Rural health research centers	4	19.0
Clinical journals	3	14.3
Health policy journals	3	14.3
Health research journals	3	14.3
Policy research organizations	2	9.5
Government research organizations	1	4.8
University	1	4.8
Definition of rural		
RUCA	9	42.9
IUC	4	19.0
MSA	3	14.3
Other	3	14.3
RUCC	2	9.5
Scope		
National	17	80.9
Regional	3	14.3
State-specific	1	4.8
Publication year		
2005-2009	2	9.5
2010-2013	0	0
2014-2017	4	19.0
2018-2021	15	71.5
Study type/design		
Quasi-experimental	12	57.1
Cohort/longitudinal	4	19.0
Cross-sectional	2	9.5
Case study	1	4.8
Qualitative	1	4.8
Other (geospacial analysis)	1	4.8
Type of outcome studied*		
Economic	9	42.9
Employment	7	33.3
Transportation to care-emergency	5	23.8

Access to providers/services	4	19.0
Provider supply	4	19.0
Quality of care	4	19.0
Transportation to care-general	4	19.0

* Because some studies explored multiple outcomes, the sums of percentages do not equal 100 percent.

Table 2: Included studies (n = 21 studies)

Author and Year	Gray (G) / Peer-reviewed (P)	Study Design	National/ regional/state	Period of Study	Definition of Rural	Type(s) of Outcomes
Holmes et al. (2006)	P	Cohort/longitudinal	National	1990–2000	MSA	Employment Economic
Ona et al. (2007)	P	Quasi-experimental	Regional/ Multi-state	1998-2000	UIC	Economic
Joynt et al. (2015)	P	Quasi-experimental	National	2003-2011	RUCA	Quality of care Economic
Thomas et al. (2015)	G	Qualitative	National	2010-2014	RUCA	Transportation to care-general Access to providers/services Employment Economic
Wishner et al. (2016)	G	Case study	Regional/ Multi-state	2015	Other	Transportation to care-general Transportation to care-emergency Access to providers/services Provider supply Employment Economic
Manlove & Whitacre (2017)	G	Quasi-experimental	National	2010-2012	RUCC	Employment Economic
Chaudhary et al. (2019)	G	Quasi-experimental	National	2011-2014	UIC	Transportation to care-emergency
Germack et al. (2019)	P	Quasi-experimental	National	1997–2016	RUCA	Provider supply
Gujral & Basu (2019)	G	Quasi-experimental	State-specific	1995-2011	RUCA	Quality of care
Merrell (2019)	G	Quasi-experimental	Regional/ Multi-state	2010-2014	RUCA	Quality of care
Troske & Davis (2019)	G	Cohort/longitudinal	National	2011-2014	UIC	Transportation to care-emergency
Miller et al (2020)	P	Quasi-experimental	National	2010-2016	UIC	Transportation to care-emergency
Mobley et al. (2020)	G	Cohort/longitudinal	National	2010-2018	RUCA	Provider supply
United States Government Accountability Office (2020)	G	Cross sectional	National	2013-2017	RUCA	Transportation to care-general
Vogler (2020)	G	Quasi-experimental	National	2003-2017	Other	Employment Economic
Alexander & Richards (2021)	G	Quasi-experimental	National	2005-2017	RUCA	Employment Economic
Bell et al. (2021)	G	Cross sectional	National	2005-2018	Other	Quality of care Employment Economic
Germack et al. (2021)	P	Quasi-experimental	National	2010-2017	RUCC	Provider supply
McCarthy et al. (2021)	P	Other: geospatial analysis	National	2010-2019	MSA	Transportation to care-general Access to providers/services
Miller et al. (2021)	P	Cohort/longitudinal	National	2006–2018	MSA	Access to providers/services
Nikpay et al. (2021)	P	Quasi-experimental	National	2012-2018	RUCA	Transportation to care-emergency

CHAPTER THREE

AN EMPIRICAL ANALYSIS OF THE EFFECT OF RURAL HOSPITAL CLOSURES ON AREA NURSING HOMES

Introduction

Access to quality healthcare services has been cited as the most important domain of the Healthy People 2010 focus areas by rural health stakeholders.[2, 5] Previous research has shown the generally unfavorable impact of rural hospital closures on physicians, nurse practitioners, and nurse anesthetists.[21, 33] Rural hospital closures and provider shortages may create geographic access to care challenges for rural populations. Our systematic review on the impact of rural hospital closures did not reveal any evidence of whether the closures of rural hospitals are associated with the subsequent closure or reduced capacity of nursing homes in the rural community. If rural hospital closures are also associated with nursing home closures, this may create yet another geographic disparity for rural residents. As the availability of healthcare services is one of the dimensions of access to care, and rural communities already experience healthcare access challenges, it is important to understand the potential impact of rural hospital closures on rural nursing homes.

Rural acute care hospitals are closing at an increasing rate, either ceasing to provide services or converting to another form of healthcare service.[10, 11] Between 2005 and 2018, 141 rural hospitals closed, 57.4% since 2013.[10] Hospitals are an important referral source of post-acute services, including skilled nursing services in nursing homes. For example, approximately 20-60% of hospitalized fee-for-service Medicare beneficiaries are discharged to a skilled nursing facility (SNF) following a 3-day

medically necessary hospital stay.[64, 65] Having a mix of payors is often necessary for nursing homes to maintain their financial viability, since Medicare's SNF benefit is typically more generous than payments for long-term Medicaid residents.[66] Without a hospital in the community, nursing homes may receive fewer referrals and admissions of Medicare beneficiaries, which may impact a nursing home's ability to remain viable.

The purpose of this study is to explore the relationship between rural hospital closures and closures of nursing homes or reductions in nursing home capacity in the same rural county, as measures associated with the underlying construct of access to care. This study adds to the body of knowledge that examines the effect of rural hospital closures on the rural economy, the healthcare workforce, and access to rural healthcare services, by studying the effects of rural hospital closures on another type of healthcare facility in the same community. As policymakers and healthcare leaders consider future rural hospital closures, the results of this study will help to inform them regarding the potential downstream effects of rural hospital closures on nursing homes and access to care.

Methods

Study Design and Population

This study used a generalized difference in difference design, with county and year fixed effects, to estimate the relationship between rural hospital closures and the number and capacity of nursing homes in the same county. We compared the pre-post difference in the number and capacity of nursing homes in each county in which a rural hospital closure occurred between 2005 and 2018 with the number and capacity of nursing homes in a matched comparison group of rural counties with hospitals but

without a hospital closure. The county and year fixed effects control for time and group invariant characteristics that might influence the dependent variables.

We used publicly available rural hospital closure data, from 2005 through 2018, from the Cecil G. Sheps Center for Health Services Research at the University of North Carolina Chapel Hill.[10] These hospital closure data were compiled from the Centers for Medicare and Medicaid Services, the National Rural Health Association, the federal Office of Rural Health Policy, as well as news alerts and Internet searches.[10] These data were linked to county-level nursing home data from LTCFocus, a publicly available dataset from Brown University Center for Gerontology and Healthcare Research.[67] LTCFocus is sponsored by the National Institute on Aging (1P01AG027296) through a cooperative agreement with the Brown University School of Public Health. This dataset includes characteristics of all long-term care facilities, including nursing homes, by individual facility and aggregated to the county and state level. We also used publicly available data from the Health Resources and Services Administration Area Health Resources Files (AHRF) from 2006-2021 for population, median income, and provider supply data by county.[68] We used the combined AHRF dataset created by Griffith et al. (2021), which included AHRF data from 2006-2018, and added the additional AHRFs from 2019-2021.[69] The methodology used by Griffith et al. (2021) included replacing missing data with census data, linear interpolation to convert annual to monthly data, and hot deck imputation to impute missing data.[69] This study looks at the effects of hospital closures that occurred between 2005 and 2018. The AHRF and LTCfocus data represented the first full year of county characteristics and nursing home data after hospital closure. A full five years of county level nursing home data was available for

nursing home closures that occurred from 2005 through 2014. For the closures in years 2015-2018, fewer than 5 years of data were used for analysis.

Measures

The independent variable was rural hospital closure by county, measured annually, from 2005 through 2018 (see Appendix A). A closed hospital ceased to provide acute care services in a given year following closure, however it may have subsequently offered other health-related services following the termination of acute care services. We did not consider a hospital closed if it: "Merged with, or was sold to, another hospital but the physical plant continued to provide inpatient acute care, converted to critical access status, or both closed and reopened during the same calendar year and at the same physical location."[43] The unit of analysis for this study was county-year, as the data used for the variables of interest, identification of the comparison group, and the control variables were all at the county level. We counted closure as any county-year there had been a closure observed, regardless how long. Therefore, each year is a cumulative effect of all counties having experienced a closure. Counties with hospital closures may have had more than one hospital in the county at the time of closure. There were two instances of hospital closures in the same county and in the same year. Multiple closures in the same county-year were counted as one county-year, as the impact of a hospital closure was assumed to be similar if there was one hospital closure with 50 beds, for example, or two closures with 25 beds each.

The Sheps Center, which is the source of rural hospital closure data for this study, defines a rural hospitals as: "any short-term, general acute, non-federal hospital that is a. not located in a metropolitan county OR b. is located in a RUCA type 4 or higher OR c.

is a Critical Access Hospital (CAH)".[10] The Sheps Center uses Rural–Urban Commuting Area (RUCA) codes in their definition of rural. RUCA codes are based on census tracts, however the unit of measurement for this study is county-year. Therefore, we used a county-based measure, Rural–Urban Continuum Codes (RUCC), and considered the county to be rural if it has been assigned a RUCC code of less than or equal to 3, indicating a non-metropolitan county.[28] This definition is consistent with other definitions for rural found in the literature.[28, 62] The Centers for Medicare & Medicaid Service (CMS) created the CAH designation in 1997 to provide financial assistance via alternative funding and other benefits in response to the increasing number of rural hospital closures.[70] Hospitals must meet specific eligibility for CAH status, including having 25 or fewer acute care inpatient beds and much be located more than 35 miles from another hospital, however CAH designation is not defined as being located in a rural county. Since rural county designation was required for the selection of the comparison group, as our data was county-based, we were unable to identify counties with CAHs in our comparison group or ensure all counties with CAHs were included in the study sample. Thus, after applying a strictly geographic definition of rural hospitals at the county level to the Sheps Center hospital closure data, 103 rural hospital closures remained (See Figure 3).

We examined two dependent variables, associated with the underlying construct of access to care, to determine which are most sensitive to hospital closure and the timing of those effects. Our primary dependent variable was the number of nursing homes in the county. In addition, we also considered nursing home shrinkage over the same time period by examining changes in the number of nursing home beds. We controlled for

within county time-varying characteristics by including county-level control variables including population, number of primary care physicians, the percent of multi-facility nursing homes, the percent of nursing home residents with Medicaid as their primary payor, the percent of for-profit nursing homes, and median household income. These variables were chosen as they have been shown to have a potential impact on the financial and clinical outcomes of counties, healthcare organizations, and nursing homes directly, which may affect nursing home viability. Because counties with hospital closures may or may not have been the sole hospital in the county at the time of closure, our dependent variables may have captured reduction in acute care hospital capacity as well as its elimination.

We identified a national comparison group of rural counties that contained at least one continuously operating acute care hospital, but did not experience a hospital closure during the measurement period. Among all possible counties, those were excluded from the comparison group if they were assigned a RUCC level less than or equal to 3, or never had an acute care hospital in the county during the study period. The comparison group was matched on county characteristics without replacement, and up to 10 matched counties were randomly chosen for each treatment county. Counties not selected for inclusion in the comparison group remained in the pool of candidate counties if not selected. Thus, the comparison group consisted of up to 10 unique counties matched on population age >65 +/-1,500, and the same RUCC level for each treatment county as of 2006.

Analyses

We calculated descriptive statistics for the dependent and control variables (See Table 3). We trended rural hospital closures over the study period (See Figure 3) and estimated a generalized difference in difference model with county and year fixed effects. SAS 9.4 and R statistical environment were used for data management. Regression and analysis were conducted in Stata/SE 17.1. We used the following regression model to provide estimates for each of the dependent variables in the model:

$$Y_{ct+j} = \alpha + \beta\,(Treatment_c * Post_t) + \gamma X_{ct} + \eta Z_{ct} + \delta County_c + \vartheta Time_t + \varepsilon$$

Y_{ct+j} represents dependent variables for nursing homes, located in a specific county (c), at a specific time (t), relative to year of closure (j). The *treatment* variable represents a rural county with a hospital that closed. *Post* indicates whether or not the county experienced a hospital closure. *X* represents the aggregated county-level nursing home characteristics and *Z* represents county population controls. County-level fixed effects are represented by the vector *County*, time fixed effects are represented by the vector *Time* (year), and the error term, clustered by county, includes all other unobservable factors that might bias the relationship between the treatment and the dependent variables.

One of the assumptions of the difference in difference design is that any confounder that affects the groups are time invariant, and that any confounders that vary over time are group invariant.[71] The treatment, hospital closures, occur throughout the study period, and do not occur at a single point in time, as in some difference in difference studies. We plotted the average outcomes of the dependent variables by year over the study period, for the study group, comparison group, and the pool of eligible

counties from which the comparison group was chosen, to evaluate the common trends assumption of the fixed effects model (See Figure 4). The lines appear to be trending in the same direction and are generally parallel. Although the comparison group plot lines appear to have less variability, that is likely due to the larger number of observations in those groups, compared with the treatment group.

Results

The characteristics of the study group (n=103) and matched comparison group (n=880) can be found on Table 3. A third group of all rural counties with at least 1 hospital that did not close (n=1427) is included for reference. The groups were similar across characteristics, although a higher average number of nursing home beds were observed in the closure group (281.26, compared with 245.23 in the matched comparison group) as well as greater prevalence of for-profit organizations in the closure group (71.57, compared with 59.98 in the matched comparison group). Figure 4 shows the trends in the nursing home outcomes of interest in this study, from 2005-2019. Both the average number of nursing homes and the average number of nursing home beds decreased during the study period.

The results of the 2-way fixed effects regression (Table 4) indicate that every rural hospital closure was associated with an average loss of 0.072 nursing home facilities in the county ($p<.01$). We found a significant decrease in the number of nursing homes from 2008 through 2019 relative to 2006, ranging from 0.046 fewer nursing homes in 2008 ($p<0.05$) to 0.290 fewer nursing homes in 2019 ($p<.001$). Significant results were also found for nursing home % Medicaid (0.0014, $p<.01$), nursing home % for-profit (-0.0012, $p<.001$), population (0.0001, $p<.01$), median household income (-0.0001, $p<.01$),

number of primary care physicians (0.0099, p<.001). Rural hospital closure was not significantly associated with nursing home % multi-facility. Rural hospital closure was also estimated to be associated with a loss of 4.65 nursing home beds in the county (p<.01). We found a significant decrease in the number of nursing home beds from 2009 through 2019 relative to 2006, ranging from 4.28 fewer nursing home beds in 2009 to 19.18 fewer nursing home beds in 2019 (p<.001). Significant results were also found for nursing home % Medicaid (0.1348, p<.001), population (0.0014, p<.001), median household income (-0.0005, p<.001), number of primary care physicians (0.6376, p<.001). Rural hospital closure was not significantly associated with nursing home % multi-facility or nursing home % for-profit. In summary, the number of nursing homes and nursing home beds have been declining over time, and there is an additive effect of hospital closures.

Discussion

Previous work has found that rural hospital closures can lead to decreases in physicians and other health care providers in the community.[21] This study explores the potential impact on nursing homes within the same counties as the hospital closures. Our analyses observed that the number of nursing homes and nursing home beds have declined over time in rural counties. This may be due to decreased referrals from hospitals, but it could also be impacted by hospitals participating in alternative payment systems. Hospitals participating in alternative payment systems have been shown to decrease their nursing home referrals as a cost control measure, or to partner with nursing homes, formally or informally, to help manage patients' post-acute care, thereby increasing nursing home referrals.[72, 73] Growth of home care can also negatively impact

referrals to nursing homes, as home care can be viewed as a less costly viable alternative to nursing home care. Additionally, rural hospital closures are associated with decreases in the number of nursing homes and nursing home beds within the county, potentially as a result of decreased referrals from acute care hospitals that have closed.

There may also be other, unmeasured factors potentially influencing nursing homes. Length of stay has been decreasing overall in nursing homes, due to market and financial pressures such as bundled payments, accountable care organizations and Medicare Advantage programs, all of which incentivize decreasing costs.[57, 74] Consequently, all of these forces can have a positive or negative effect on nursing home viability, referrals and admissions.

It is plausible that the factors influencing rural hospital closures are simultaneously impacting nursing homes. The same factors associated with rural hospital closures, such as poor financial performance, unfavorable payor mix, reimbursement policies, decreased utilization, are also challenges for nursing homes.[11] Likewise, market and economic factors associated with rural hospital closures, including decreased population, decreased healthcare workforce, decreased employment, and financially struggling communities, are likely to impact nursing homes as well as hospitals.[24] As the healthcare workforce decreases following rural hospital closure, the effect may be felt directly by nursing homes as family members of former hospital employees relocate out of the area, which may include nursing home staff. Similarly, population decreases following rural hospital closures may include nursing home staff, leading to increased staffing challenges and potential threats to nursing home viability. Furthermore, these factors, particularly those related to financial performance, are likely to affect nursing

homes in both rural and non-rural counties. Our findings suggest that hospital and nursing home viability are co-influenced by these factors.

This study has several limitations. First, the effects of rural hospital closures on nursing homes may occur outside the study period. Although the Sheps Center definition of a rural hospital closures includes CAHs, we were unable to identify all counties with CAHs in the available national datasets that remained open, to include the comparison group. Therefore, we excluded CAHs that closed from the analysis, and thus our results may not generalize to these counties. Excluding CAHs from the study may have underestimated the effect of hospital referrals to nursing homes, thereby limiting the effect of hospital referrals on the outcomes of interest. Similarly, the distance between the nursing home and the nearest remaining hospital following rural hospital closure may impact the likelihood of referrals. Additionally, some of the nursing home data used in this study was measured at the facility level and aggregated to the county level, which may lead to inaccurate conclusions from the aggregate data. Also, decreases in the general population as well as the healthcare provider community related to rural hospital closure may have influenced the decreased number of nursing homes and nursing home beds, by effecting nursing homes' ability to staff the facilities. Finally, the results from this analysis cannot be generalized beyond rural counties in the United States.

Conclusion

This study found that rural hospital closures are associated with decreases in nursing home facilities and beds. Our findings add to the body of knowledge regarding the effect of rural hospital closures on other healthcare services and suggest that there are co-occurring influences impacting both rural hospitals and nursing homes. Policymakers

will benefit from these findings, as understanding the relationship between rural hospital closures and nursing homes can aid in anticipating and planning for the likely impact on access to care in the community. Future work in this area should focus on the operational relationships between rural hospitals and nursing homes, to better understand the implications of hospital closures on clinical services and patient outcomes in nursing homes. Additionally, further research is needed to explore the effect of rural hospital closures on other health care services, such as mental health, home health, pharmacy, and therapy services.

Figure 3: Rural hospital closures

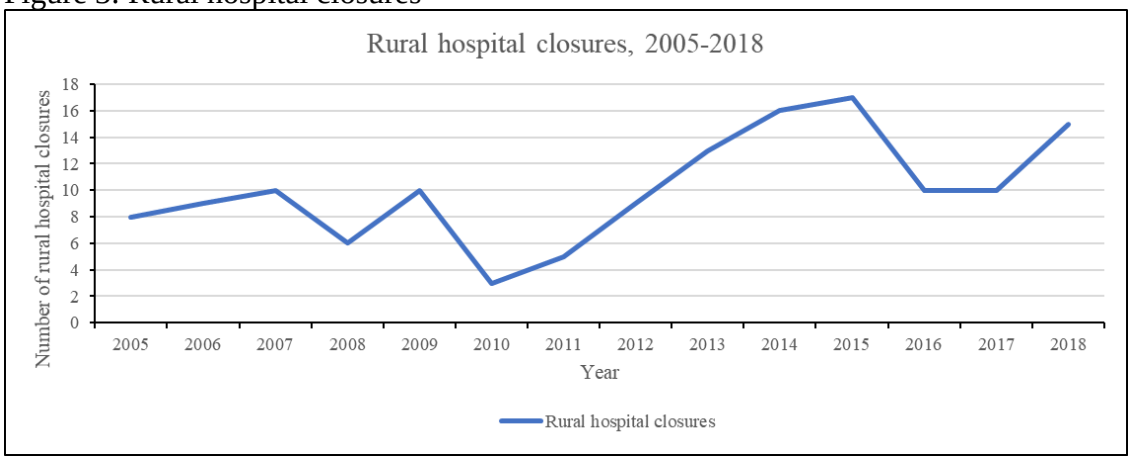
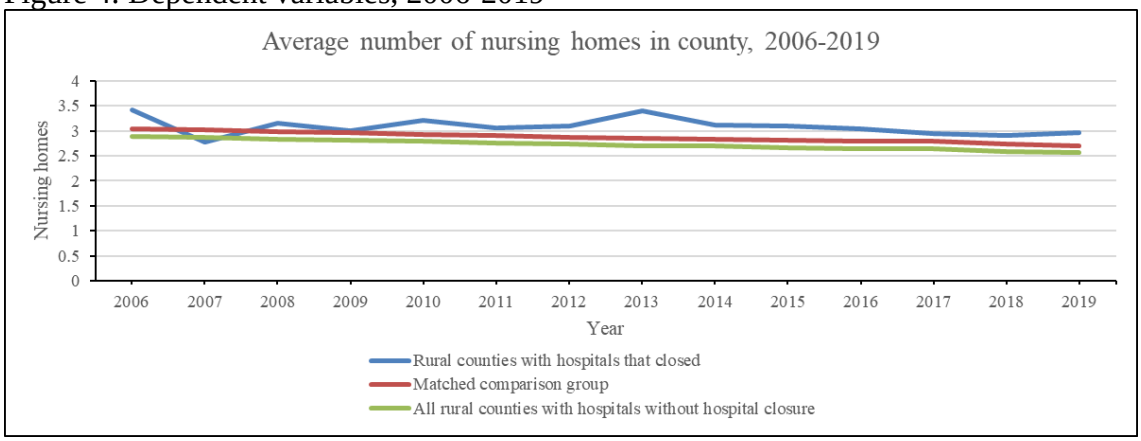


Figure 4: Dependent variables, 2006-2019



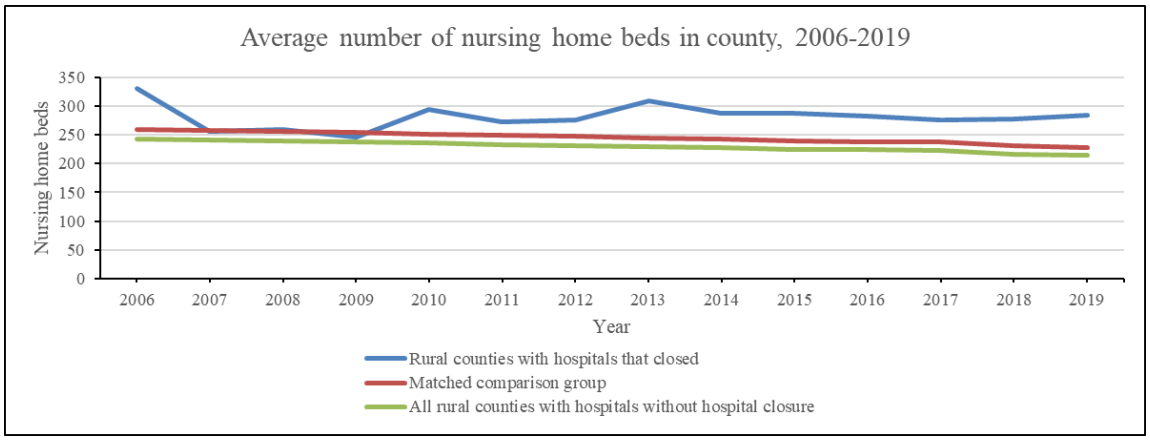


Table 3: Characteristics of rural counties, 2005-2019

	Rural counties with hospital that closed (N = 103)		Matched comparison group (N = 880)	
Characteristic	**Mean**	**Standard error**	**Mean**	**Standard error**
Population	32760.05	45.44	28931.14	50.30
Median household income ($)	39293.08	861.12	42530.31	967.73
Number MD's, primary care	13.92	0.20	14.12	0.12
Number nursing homes	3.09	0.05	2.88	0.03
Number nursing home beds	281.26	5.69	245.23	2.60
Nursing home % for-profit	71.57	0.89	59.98	0.28
Nursing home % multi-facility	54.78	1.03	52.27	0.44
Nursing home % Medicaid	70.07	0.29	65.41	0.17

Table 4: 2-Way fixed effects regression results for the effects of rural hospital closure on nursing homes, 2005-2019

	Number of nursing homes		Number of nursing home beds		
Rural Hospital Closures	**Coefficient**	**SE**	**Coefficient**	**SE**	
	-0.0720 **	0.021	-4.6501 **	1.722	
Year					
2006					
2007	-0.0189	0.015	0.0441	1.185	
2008	-0.0457 *	0.015	-1.8030	1.216	
2009	-0.0720 ***	0.015	-4.2879 ***	1.188	
2010	-0.0964 ***	0.015	-5.3192 ***	1.197	
2011	-0.1350 ***	0.015	-8.2820 ***	1.216	
2012	-0.1547 ***	0.015	-9.3675 ***	1.245	
2013	-0.1657 ***	0.016	-9.8501 ***	1.290	
2014	-0.1796 ***	0.017	-11.2036 ***	1.339	
2015	-0.1989 ***	0.018	-12.5535 ***	1.423	
2016	-0.2173 ***	0.018	-12.8843 ***	1.467	
2017	-0.2244 ***	0.019	-13.3023 ***	1.552	
2018	-0.2775 ***	0.021	-17.7856 ***	1.683	
2019	-0.2898 ***	0.021	-19.1836 ***	1.683	
Population	0.0001 **	0.000	0.0014 ***	0.000	
Median household income	-0.0001 **	0.000	-0.0005 ***	0.000	
Number MDs, primary care	0.0099 ***	0.002	0.6376 ***	0.127	
Nursing home % Medicaid	0.0014 **	0.000	0.1348 ***	0.034	*<.05
Nursing home % multi-facility	-0.0002	0.000	-0.0031	0.012	**<.01
Nursing home % for-profit	-0.0012 ***	0.000	-0.0127	0.017	***<.001

CHAPTER FOUR

PERCEPTIONS OF NURSES DELIVERING NURSING HOME VIRTUAL CARE SUPPORT: A QUALITATIVE PILOT STUDY

Introduction

Avoidable hospitalizations among nursing home residents result in poorer health outcomes and excess costs.[75, 76] Hospitalized older patients have greater risk of general deconditioning and decreased independence, adverse drug effects, dehydration, hospital-acquired infections, malnutrition, and increased risk of falls and fractures compared to younger patients.[77-80] As much as 67% of hospitalizations of nursing home residents are avoidable; although estimates differ, the consensus among researchers and clinicians that opportunities exist for reducing transfers.[81-84] States spend between $47 million to $224 million annually on avoidable transfers.[81, 82] Consequently, efforts to reduce avoidable hospitalizations have been a priority over the recent decade. However, many potential interventions are time-intensive, require dedicated clinical staff, and nursing homes are chronically understaffed.[76, 85, 86]

In 2012, the Centers for Medicare & Medicaid Innovation (CMMI) launched a program to identify novel solutions to reduce avoidable hospitalizations.[76, 87] The Optimizing Patient Transfers, Impacting Medical Quality, and Improving Symptoms: Transforming Institutional Care (OPTIMISTIC) project was one of seven sites selected as "enhanced care & coordination providers" (ECCPs) and was implemented from 2012 to 2020.[88] Nurses in the OPTIMISTIC program provided resident care while collaborating with nursing home staff to comprehensively review care plans and medical records to proactively identify strategies to prevent transfer, and to improve nursing home staff's patient assessment skills and knowledge of evidence-based practices. Evidence from

OPTIMISTIC's phase 1 clinical demonstration project and the phase 1 evaluation of the initiative overall demonstrated reductions in avoidable hospitalizations without increasing mortality.[76, 89, 90]

Healthcare innovators tout telehealth and virtual care services as possible solutions to deliver health services and share information among providers, while ameliorating staffing shortages faced by nursing homes. In long-term care settings, 79% of nursing homes have partially implemented telehealth, while 16% of nursing homes use none.[91] Telehealth application examples in nursing homes include engaging residents' families in care planning sessions, palliative care, or increasing clinical coverage on evenings and weekends.[92, 93] Long-term care providers, including nursing homes, may benefit from telehealth in the form of virtual care support because it is a scalable and focused approach to addressing complex needs of residents.

A virtual program based on the principles of OPTIMISTIC was developed in the spring of 2020 with the goal of expanding the reach of the program's services. A pilot implementation of the virtual program coincided with restrictions on visitors' and staff's physical access placed on nursing homes as the COVID-19 pandemic began.[94] Nurses were connected with nursing homes via email and Zoom communication and were given remote access to electronic medical records (EMRs) to support facility-based staff (K. Unroe, personal communication, March 24, 2021). The COVID-19 pandemic accelerated the offering and broader use of telehealth services leading to lasting changes. However, the role of telehealth capabilities to enhance or support nursing home staff is not well-understood.

In this study, we explore the perceptions and experiences of the nurses that piloted a virtual care support project in 11 nursing homes in a midwestern state. Specifically, we sought to identify nurses' perceived facilitators of, and barriers to, the effectiveness of delivering a novel virtual care support program. We provide insights into crucial elements important to the implementation of similar virtual care support models and the role of telehealth in bridging healthcare workforce gaps.

Methods

Study Participants

We conducted eight semi-structured interviews with open-ended questions and utilized thematic analysis approaches to extract key information from the interview transcripts. Due to the relatively small population involved in OPTIMISTIC, and to increase validity through data triangulation, all eight nurses were invited to participate in an individual qualitative interview—all nurses participated (hereafter participants).[95] Since all of the participants also supported the OPTIMSITC program in an embedding in-person role, the interviewed nurses could compare and contrast their perceptions of care delivery. Participants were recruited via email to participate in the study, informed their participation was voluntary, and confidentiality of responses was maintained. Participants' rights were protected by obtaining informed consent. This study was approved as exempt by the institutional review board at our university.

Data Collection

C.M. developed an interview guide, including questions regarding the participants' activities and responsibilities during the virtual pilot, their perceptions of the effectiveness of the services they delivered during the pilot, and perceived

advantages/disadvantages of delivering program services virtually (see Appendix B). Previously published research on the OPTIMISTIC project, as well as discussions with V.Y, K.U., and J.B. informed the development of the interview guide.

Individual, semi-structured interviews with open-ended questions were conducted by Zoom during May and June of 2021, each lasting approximately 60 minutes. C.M. conducted all eight interviews and was joined by V.Y. for four of the interviews. Interviews were recorded and recordings were transcribed using Otter.ai Version 2.3.93 (Otter, Mountain View, CA). A transcription protocol was developed and C.M. proofread the transcripts according to the established protocol.

Analyses

C.M. and Y.T. used a thematic analysis approach, which is appropriate for identifying shared experiences and perceptions common among the participants and can be used with small data sets.[96-98] C.M. and Y.T. used Dedoose Version 9.0.17 (Dedoose, Hermosa Beach, CA) for coding and analysis. C.M. and Y.T. first independently screened four transcripts to develop initial themes and codes and then met to review their independent findings. After consensus was reached on an initial set of codes, C.M. and Y.T. applied and tested codes with the remaining four transcripts. Through an iterative process of coding transcripts and revising the codebook as needed, a final codebook was created by consensus that captured the ideas relevant to the research questions.[95] Initially, two transcripts were coded by C.M. and Y.T. to test the codebook, and additional codes were added such as, "Keys to success/recommendations" and "Unknown." The process was repeated for the remaining six transcripts. Preliminary themes and subthemes were identified by both authors independently, then combined through consensus. The eight

transcripts were again reviewed, applying the initial themes and subthemes, to further define and refine the themes.

C.M and Y.T. discussed the findings with J.B. to further clarify the findings and revise themes and subthemes. C.M. and Y.T. then extracted illustrative quotes representing each theme and subtheme. The themes, subthemes, and illustrative quotes were shared with J.B. and K.U., both of whom assisted in interpretation.

Results

Participant Characteristics

Seven participants (87.5%) were white, and all eight participants were female. The ages of the participants were: 35-44 (37.5%), 25-34 (25%), 55-64 (25%) and 65-74 (12.5%). During the pilot of the virtual program, three of the participants provided OPTIMSTIC care support services for three nursing homes each, two participants provided care support services for one nursing home each and assumed additional OPTIMISTIC program responsibilities, and three participants transitioned into OPTIMISTIC program management positions and did not provide care support services. Three themes were identified: relationships, communication, and access to information. Illustrative quotes for each theme and subtheme are presented in Table 5.

Theme 1: Relationships

Most participants identified a trusted relationship between the nurses providing virtual care support and the nursing home leadership and clinical staff as important to encourage collaboration and accomplish program goals. In order to build trust, virtual program nurses needed to be viewed as a credible part of the team by the nursing home staff. Two participants reported, "*You have to meet them where they're at and be on their*

team, not pull them over to what you're doing" (Participant 8), and "…*essentially just stay humble and learn from them the way that you want them to learn from you"* (Participant 1). Frequent turnover among nursing home staff and leadership posed a barrier to relationships, affecting communication and follow-through on the virtual program nurses' recommendations. Participants reported that staff turnover not only resulted in the need for frequent reorienting of nursing home staff to program goals and processes, but also increased the nursing home staff's workload, and thus less time to engage with the program or virtual program nurses. Nursing homes vary in their needs, wants, responsiveness, and receptivity to recommendations such that a high level of engagement was an important key to implementation of the program and necessary for positive relationship-building. For example, one participant reported, "*They have to want our assistance, and they have to want to learn and to grow, otherwise it's not going to be a productive process"* (Participant 7). Trust and rapport between virtual program nurses and nursing home leadership facilitated dissemination of information to clinical staff. The restrictions and operational changes required by COVID-19 were a priority for nursing home staff and leadership. This resulted in a barrier to engagement with virtual program nurses in their effort to reduce avoidable transfers. Additionally, in-person onboarding of the virtual program nurses was not possible due to the COVID-19 restrictions but may have been helpful in establishing expectations and building relationships. As one participant reported, "*So, with the virtual role without an onboarding process, it's hard to have those relationships"* (Participant 3).

Participants offered suggestions to enhance professional relationships, including in-person onboarding for virtual program nurses during implementation, customizing the

program to meet the unique needs of each nursing home, and ensuring a collaborative approach, rather than authoritarian, when working with nursing home staff.

Theme 2: Communication

Participants identified the ability to communicate directly with nursing home clinical staff regarding the care of the nursing home residents as essential for implementation of the program as well as affecting the ability to build relationships. Communication between the virtual program nurses and nursing home staff was routed through each nursing home's director of nursing (DON) in the form of emails that included recommendations and opportunities for improved resident care. Participants reported receiving little or no feedback regarding which recommendations had been communicated to clinical staff or implemented. One participant stated, "*The frustration for our team was that they didn't tell us what they were doing with any information. So, it seemed to be a one-way communication"* (Participant 5). Practically, the lack of feedback also created inefficiencies as the virtual program nurses need to search the electronic medical records (EMRs) for pertinent information. While communicating observations and recommendations to the DONs was beneficial in order to keep nursing home leadership informed, participants perceived that direct communication with the clinical staff would be more efficient and more effective in preventing exacerbation of illness and potential hospital admissions. For example, one participant reported, "*So yeah, like I said, it would be way more effective, and we could get more interventions and more things in place if we were talking to the provider, because they're the ones that are really going to take care of that stuff"* (Participant 4). Additionally, during the virtual pilot the program

nurses were not able to speak directly with nursing home residents or families, which presented a challenge for advanced care planning conversations.

Most of the participants offered suggestions for improving communication and thereby increasing their perceived effectiveness, including direct bi-directional communication with the clinical staff. Directly communicating with the clinical staff would eliminate the need for a communication intermediary, thereby encouraging feedback and collaboration among the healthcare team and could provide increased efficiency and effectiveness for virtual program nurses. This increased communication and collaboration should not impose more work on the nursing home staff; the focus needs to be on identifying opportunities to "off-load" staff. One participant reported, "*We weren't talking to providers…But I know moving forward that's something that we've identified, which certainly leverage(s) what we have to offer and how we can do it without imposing more burden upon that primary team that we have"* (Participant 6).

Theme 3: Access to Information

Virtual program nurses lacked consistent access to hospital EMRs, or timely paper records, for patients returning from the hospital or specialist visits. Missing and delayed information limited the ability of virtual program nurses to make timely recommendations specific to residents' most current health status. Interviews revealed that it was common for residents to return to nursing homes following hospitalizations without discharge summaries, sometimes for days, creating obvious challenges to adequately care for these residents. One participant reported, "*…there was a huge thing where they weren't even getting the discharge summaries. They [patients] were showing up, and they weren't getting them [discharge summaries] actually for days"* (Participant

4). Another participant reported, "…*sometimes you even have to wait a few days before you can get those final discharge notes. The information that would come from the hospital when someone was transferred or went out to the ER [emergency room] and back was usually horrendous"* (Participant 2). Lack of access to information not only leads to gaps or delays in care for the nursing home residents, but it also takes valuable additional time for the virtual program nurses to locate and obtain necessary information. Hospital records were not the only medical record concern, and in some cases the nursing home EMRs were incomplete or had inaccurate documentation. One participant stated, "*We could read the nurse's notes, but once again, looking virtually, it's only as good as the information that's in the EMR"* (Participant 2). Furthermore, nursing home use of EMRs varied between facilities, and sometimes within facilities, creating more challenges for virtual program nurses. As one participant reported, "*…although several of the facilities use the same EMR system, they all use it differently. They're all within the same organization. And they all use it differently"* (Participant 5).

Discussion

Relationships, communication, and access to information were identified as common themes facilitating or impeding the perceived effectiveness of implementation of virtual care support programs within nursing homes, from the perspective of the nurses delivering the services. The OPTIMISTIC virtual program represented a pivot at the conclusion of the eight year demonstration project to enhance scalability and adapt the desire to reduce in-person interventions in facilities. This pilot provided an example of how a virtual care support program can be implemented and the experiences and

recommendations of the program nurses provide key insights into the elements that may contribute to the success or failure of implementation.

Relationships between providers are important in healthcare, and specifically, to the successful implementation of care support programs.[76] Trust and communication are key elements in the development and maintenance of professional relationships, and have been tied to performance.[99] Conversely, ineffective communication decreases quality of care and increases potential safety concerns.[100] Both trust and communication can be developed formally among teams through education and training programs.[101] In the work setting, the iterative process of communicating and working together helps to build trust among team members.[102] Trust among team members is essential to achieve desired outcomes, and it can be even more challenging when the team members are not proximal to each other. [99, 102] Therefore, virtual care support programs require focused attention on building and maintaining communication, trust, and relationships to achieve program goals. In the nursing home setting, frequent turnover among staff may present a challenge to building relationships and optimizing communication.[76] However, embracing the full implementation of virtual care support could help counteract the adverse effects of a high nursing workload.[103] Nurses providing services in a virtual care support program may be able to offer some continuity and redundancy during times of nursing home staff turnover.

Telehealth and virtual care support programs are reliant on medical records to provide a complete picture of the clinical situation. Access to complete, timely, and accurate medical records are best practices for continuity of care across platforms.[104] The challenges nursing homes face in receiving such information is well-documented;

approximately one-third of non-federal acute care hospitals routinely share electronic summaries of care records with nursing homes, whereas approximately 43% do not.[105] This information void is notably challenging for resident care during transitions and is likewise a challenge that virtual care support programs must overcome. Additionally, opportunities may exist to improve or enhance clinical documentation in nursing homes with virtual program nurses leading these efforts. Furthermore, having virtual support staff with access to records spanning both the hospital and nursing home could be a promising strategy.[106]

Unlike existing telehealth research related to provider-patient encounters, our study involves a telehealth service that supports providers in a resident care setting. As the use and scope of telehealth continues to expand, and new care support models emerge, additional research will be needed to evaluate the effectiveness of different virtual care support strategies in various settings and from other perspectives including other provider and the patient/resident perspectives. Future research in this area should also include cost-effectiveness analysis of virtual provider-to-provider care support services, to encourage program development that is evidence-based, targeted and cost-effective.

There are some limitations of this study. We included the entire population of nurses that worked in the virtual pilot of the program; however, it is limited to eight, which affects the robustness of the findings. The participants delivered services to nursing homes located in one midwestern state, which limits the generalizability of the study findings to other programs, geographical areas, or clinical settings. The COVID-19 pandemic affected normal work processes in nursing homes during the time of the study,

And may have influenced the nursing home staff and leadership's engagement in this program pilot.

Conclusion

Virtual delivery of services is growing in many different aspects of healthcare, and these services need to be provided effectively and efficiently. Providing virtual support to clinical providers requires the establishment and maintenance of trusted relationships and ongoing two-way direct communication to create the collaborative environment necessary to achieve program objectives. In addition to interpersonal factors, access to accurate, timely, and complete medical records is essential for continuity of care and effective interventions. In order to maintain engagement with nursing home staff, the remote clinical support must off-load their duties and provide tangible support in their efforts to deliver excellent resident care. This study has implications for nursing home and long-term care industry leaders, policymakers, and providers of similar telehealth services. Furthermore, nursing homes participating in accountable care organizations, for which patient care management is a key component, may gain valuable insight into a novel service delivery method.

Table 5: Emergent themes with illustrative quotes

Theme	Illustrative Quotes
Relationships	
• Staffing/turnover	It really depends on if any of those people are still there. Their staffing crisis is real (Participant 5). And we need to have a good plan in place for turnover of leadership, if that's going to be our main communication line, or would it be more beneficial to have a communication line with the provider? (Participant 3). You have people doing that in the nursing home, if you have your DON in place, if you have your unit managers in place, if you have your staffing and your CNAs and nurses and you have everybody there that's supposed to be there, then things should go okay. But that's why I said when it comes down to it, whether you're virtual or in person, staffing is the root of all causes. Whether it's a changing condition, a transition, anything (Participant 2).
• Building and maintaining trust	It took me a while to earn their trust (Participant 7). There's a lot of talking because you're trying to build relationships with people and get people to trust you and you've got to keep those relationships going (Participant 4).
• Nursing home engagement	I don't think it mattered how engaged or how determined and focused and objective I was on our goals, if I did not have the enthusiasm and openness from the facility, whether it be from the operational side, as far as the ED and the nursing side, we were only able to do what we were allowed to do (Participant 7). And as long as they're receptive, they can take what I say and implement it (Participant 3). Having a facility that is engaged. And not only is engaged in that, like, "Yes, I will respond to your emails, and I will do it because my boss is making me," but like, "I want to make this, I want this building to be better, I want to improve outcomes" (Participant 8).
• Onboarding/implementation	If we are going to have a relationship with the provider themselves, how do you make that happen, upfront? How do you meet them, establish yourself, get a level of trust, confidence, how do you do that? (Participant 5) In a virtual model, I would say the keys to success are establishing that crucial relationship we've been talking about and establishing the credibility and the idea that you are not policing their charting, you're looking at it in a way to benefit them and try to benefit the residents and catch things ahead of time (Participant 1). You either need an onboarding process at the beginning, so that you get to know this, you're in there, you get to know the staff, they get to know you. Being physically in there,

	sometimes, just anything that they know who you are, and they trust you (Participant 2).
• Unique needs/characteristics of each nursing home	I had to do something different for each facility, and figure out like, "Okay, well, this is the pace that they want to go at this facility. So let me do that." (Participant 7) …because if one thing we have learned is that we know that each facility is different. And that's very important to know that flexibility and creativity and imagination, are all needed to be able to figure out how to work within each one (Participant 5). Your other two facilities didn't know me, and they didn't necessarily need me as much as what the other facility did. So, there's a need, and there's the relationship. Also, I think you need both (Participant 2).
Communication	
• Frequency, channels, modalities, expectations of communication between OPTIMISTIC nurses and nursing home	I think the barriers there are similar to what we've been talking about, just with that communication, and the time that these directors of nursing or whoever our designated person was, have, and they're not like an email-focused role. And so, trying to communicate with them via email with things, that's like kind of the bottom of their list of the day (Participant 1). Virtually, there was no communication with the nursing staff. It was all with a nursing leader and administrator or a DON and that was via email (Participant 8). And I guess it ultimately depends on the director of nursing to how he or she…is she even going to take the time to print it, and give it to somebody? So, I think going forward, yes, we need to let her know what we're doing and communicate with her (Participant 4).
• Need for 2-way communication	The experience that I had with my virtual model, I got very little to no response in communication, and that was all by email (Participant 8). But without the interaction between the DON and us virtually, we had no idea whether we were being helpful. I mean, the communication wasn't there… (Participant 2)
• Need for direct access to nursing home providers	And it would have cut out the middleman so to speak, I think it would be more efficient timewise (Participant 8). I think, to me, I see the most value, as far as establishing communication, that we kind of could start to get to, would be through that provider (Participant 6).
• Effect of relationships on communication	I think it would make its way through the provider, or the MDS coordinator would be a good person, I think they rarely leave (Participant 3). I think that the trust with OPTIMISTIC as a program existed, otherwise they wouldn't have agreed to participate.

	But definitely, like let there wasn't enough time or reciprocated communication, I think for those buildings to recognize the credibility of the nurses that were trying to help (Participant 1). Had I had time with the facility and had a rapport with the providers, maybe I would have called and said, "Hey, what do you think about this?" (Participant 4)
Access to information	
• Timely access to complete and accurate nursing home and hospital records	And then, I mean, from an operational standpoint, having access to view what you need to view in their electronic medical record: their labs, diagnostics, provider notes… (Participant 1)
• Quality and quantity of data	And I will say that, generally speaking, nurses' notes did not give a lot of information. But when you could review provider progress notes, it seemed like that was more revealing (Participant 8).

CHAPTER FIVE

CONCLUSION

Access to healthcare services is a priority for all people in order to maintain and promote health, and is a specific priority for rural residents, as rural populations tend to lag behind non-rural populations in health outcomes. An important aspect of access to care is an adequate supply of healthcare providers and services. Since geographic maldistribution of physicians negatively impacts rural areas to a greater degree than non-rural areas, it is important to evaluate the other healthcare services that may be needed by rural populations. Rural hospitals continue to close at an increasing rate, which can lead to physicians also leaving the market. While the contributing factors leading to rural hospital closures have been studied, less is known about the impact on the community following rural hospital closures, including the effect on other healthcare services. Communities experiencing healthcare service disruptions may employ strategies to mitigate the effects, including utilizing telehealth/virtual services to provide care or services previously delivered in-person. The purpose of this dissertation was to examine the effects of rural hospital closures on the community, healthcare services, and access to care, and provide a qualitative assessment of telehealth as a strategy to bridge gaps in provider access. Specifically, Chapter 2 employed a systematic review of the literature to summarize the evidence of the effects of rural hospital closures on the community, specifically the health and economic impacts, and identify gaps for future research. Chapter 3 continued the examination of the effects of rural hospital closures, and explored the relationship between rural hospital closure and nursing homes. Chapter 4

described the perceptions of nurses providing care management support to nursing home clinical staff, in a virtual pilot program.

Although a hospital closure in any location may have a considerable impact on the community, the closure of a rural hospital may have disproportionately more substantial implications for the economy and employment, health outcomes, and access to care. We conducted a systematic review of the peer-reviewed and "gray" literature, published from January 1, 2005, through December 31, 2021, resulting in 21 publications included in this study. One of the main findings of this systematic review is that the topic is not extensively researched, and extant research is predominately recent, with 71.5% of the studies published between 2018-2021. This may be due to the increasing rate of rural hospital closures in recent years. Additionally, more than half (57.1%) of the included studies were found in the gray literature, 57.1% used a quasi-experimental research design, and 38.1% were produced by economic research organizations and rural health research centers. Economic outcomes were the most frequently studied outcome, and 89% of the studies that examined the economic effects of rural hospital closures found decreases in income, population, community economic growth, and increases in poverty. Another main finding is that access to care, primarily measured as increased travel time to services, is negatively impacted. The average increase in distance to obtain services previously offered by a closed rural hospital was approximately 20 miles. Rural hospital closures can harm local economies and reduce access to care, problems which could result in poor health outcomes in the community over time. These findings can help to inform community leaders and policymakers, so they can better anticipate likely negative

economic outcomes when anticipating a hospital closure, and work to mitigate the effects.

Chapter 3 adds to the body of knowledge that explores the effects of rural hospital closures on rural healthcare services. In this study, a generalized difference in difference study design with county and year fixed effects was utilized to estimate the relationship between rural hospital closures and the number and capacity of nursing homes in the same rural county. This study uses a publicly available dataset from the Cecil G. Sheps Center for Health Services Research at the University of North Carolina Chapel Hill, to identify rural hospital closures from 2005-2018. LTCFocus data from Brown University Center for Gerontology and Healthcare Research provided national nursing home data, aggregated to the county level, and Health Resources and Services Administration Area Health Resources Files (AHRF) were used to identify county-level population and income data. This study examined the impact on nursing homes of 103 rural hospital closures between 2005 and 2018. We found that the number of nursing homes and nursing home beds declined over time in rural counties, and that rural hospital closures are associated with additional decreases in the number of nursing homes and nursing home beds within the county. However, these declines may be associated with unmeasured factors and other factors also influencing rural hospital closures. This study suggests that hospital and nursing home viability are co-influenced by these factors.

When communities experience healthcare disruptions, for any reason, they may seek to mitigate the effects of the disruption by finding an alternative method to deliver needed services. In an effort to scale up and expand a care support program previously offered in-person in nursing homes by on-site nurses, the OPTIMISTIC program pivoted

to a virtual pilot to provide services virtually. OPTIMISTIC nurses collaborated with nursing home clinical staff to review care plans and medical records, to proactively identify nursing home residents at risk of exacerbation of illness or risk of hospital transfer, and to develop strategies to prevent hospitalization. Chapter 4 described the findings of a qualitative study that examined the perceptions of the eight nurses delivering these virtual services, related to their perceived effectiveness and the facilitators and barriers they encountered when providing these virtual care support services to the clinical staff of 11 nursing homes. With the rise of use and acceptance of telehealth and virtual healthcare services, and the potential to share information electronically between providers, this study provided timely insight into three key elements that are most important to the implementation of a virtual care support program in nursing homes. One key finding from this analysis is that trusted relationships between the virtual care support program nurses and the nursing home leadership and clinical staff are critical to program success. Trust and credibility were viewed to be essential to the relationship building necessary for open communication and follow-through on recommendations. Staff and leadership turnover in nursing homes is viewed as a significant barrier to accomplishing goals, and those critical relationships must continuously be rebuilt. In-person on-boarding and customized programming may facilitate collaboration. During the pilot, communication between the OPTIMISTIC nurses and the nursing home clinical staff was routed through the nursing home leadership, which was a perceived barrier. Bi-directional, direct communication between the parties was important to perceived effectiveness of the program, and to relationship building. Additionally, access to information was seen as an essential element for both

the OPTIMISTIC nurses as well as the nursing home clinical staff. Off-site nurses providing virtual clinical support needed unrestricted access to all relevant electronic medical records in order to do their jobs. Similarly, nursing home clinical staff required access to all relevant clinical records, especially hospital records related to nursing home residents that had been hospitalized, which were often not available in a timely fashion. Providers providing services virtually are reliant on medical records to provide a complete picture of the clinical situation. Therefore, access to timely, accurate and complete information is a best practice.

Healthcare service disruptions can have a significant effect on the health and wellbeing of a community. This dissertation adds to the body of knowledge regarding the impact of rural hospital closures on communities and healthcare services, as well as providing additional insight into the use of virtual care delivery as a means of increasing access to care. Additional research is needed to fully understand the downstream effects of rural hospital closures, so policymakers and decision-makers may better anticipate the effects and implement mitigation strategies. Additionally, given the trends in rural hospital closures and persistent provider shortages, this dissertation provides additional insight into the use of telehealth and virtual care delivery as a means of increasing access to care.

APPENDICES

Appendix A: Chapter 3-Independent, dependent and control variables with data sources

Independent variable	**Data source**
Rural hospital closures	Sheps Center
Dependent variables	**Data source**
Number nursing home facilities	LTCfocus
Number nursing home beds	LTCfocus
Control variables	**Data source**
Population	AHRF
Percent multi-facility	LTCfocus
Median household income	AHRF
Percent Medicaid	LTCfocus
Number primary care MDs	AHRF
Percent for-profit	LTCfocus

Appendix B: Chapter 4-Interview Guide

Thank you for agreeing to participate in this interview. This interview is part of a research study entitled 'Perceptions of Nurses Delivering Nursing Home Virtual Care Support: A Qualitative Pilot Study.' The purpose of this study is to learn the perceptions and experiences of nurses piloting a virtual application of the OPTIMISTIC project.

This study has been approved by the (blinded) Institutional Review Board. Your participation is voluntary, and you are free to discontinue the interview at any time or refuse to answer any questions. I will be recording this interview for research purposes, and the recording will not be shared with anyone outside of the research team. Your responses are confidential, and no information that identifies you will be shared with anyone outside of the research team. The interview is expected to take approximately 30-45 minutes.

Background:

1. Please describe the nursing facilities you worked with during the in-person phase of the OPTIMISTIC project.
    - Number of nursing facilities (0, 1, 2, 3)
        - If 0, SKIP to Question 2
    - Total number of beds you were responsible for?
    - Any unique patient populations?

2. Did you receive any training from the OPTIMISTIC program that was different from nursing training you've previously received? Please tell me about it.

The following questions relate to the OPTIMISTIC program during the virtual pilot.

3. Please describe the nursing facilities you worked with during the pilot of the virtual approach to the OPTIMISTIC project.
    - Number of nursing facilities (0, 1, 2, 3)
        - If 0, SKIP to Question 4
    - Total number of beds you were responsible for?
    - Any unique patient populations?

OPTIMISTIC has three program goals including 1) improve medical care, 2) enhance transitional care, and 3) support palliative care. I will ask you about each goal specifically in terms of your activities and responsibilities toward that goal in the virtual format.

4. Please describe your activities and responsibilities during the virtual pilot, in terms of program goals to improve medical care:

- Early recognition and management of acute conditions; use of INTERACT tools
- Collaborative care reviews
- Training and mentorship for nursing home staff

5. Please describe your activities and responsibilities during the virtual pilot, in terms of program goals to enhance transitional care:

- Improving provider-to-provider communication

- Family and caregiver education of transition procedures
- Root cause analysis

6. Please describe your activities and responsibilities during the virtual pilot, in terms of program goals to support palliative care:
- Systematic advance care planning; POST
- Improved support and education for palliative care
- Increased access to pain and symptom management

7. Previous studies have found that OPTIMISTIC RNs were seen as providing "an extra set of hands" to help facility staff manage their heavy workloads, which facilitated adoption of the program.
- Were you able to provide this benefit during the virtual pilot or was there a substitute of any sort? (Probe: ACP conversations, teaching staff/family/residents, EMR access, evaluating changing resident conditions)

8. Another factor that was previously identified as important to facilitating adoption of the program was the OPTIMISTIC RN fostering relationships and communication with the nursing facility staff.
- Were you able to foster relationships and communication with the nursing staff during the virtual approach? (Probe: providing information, liaison between nursing staff and providers, timely follow-up to clinical issues, support staff)
- If you were in-person previously, did relationships or communication change when you began working virtually?
- As virtual staff, about how often do you communicate with the nursing facility on an average day, and who usually initiates the communication (OPTIMISTIC RN or nursing facility staff?)

9. We've talked about some of the program goals and your duties and responsibilities. How successful do you feel you were during the virtual pilot in achieving or helping the nursing facility to meet these goals?
- Did you encounter any barriers? If so, did you identify any workarounds?
- How do you think the organization is doing on carrying out the activities/goals of the OPTIMISTIC project on their own today?
- Do you feel anything needs to be added to the program to make the virtual approach more sustainable?

10. What do you feel were the advantages and disadvantages of the virtual approach over the in-person model? (Probe: If RN not familiar with in-person model, ask about perceived benefits and drawbacks of virtual model)

11. Are there key elements essential to the success of the virtual approach to OPTIMISTIC? If so, please explain. (Probe: facility leadership support, champion inside facility, staff turnover, equipment, communication, equipment, policies)

12. Satisfaction: (Probe for all questions: Scale of 1(low) – 5(high); Why did you feel that way?)

- How satisfied or dissatisfied with the virtual pilot do you think the facility staff were?
- How satisfied or dissatisfied with the virtual pilot do you think the facility residents were?
- How satisfied or dissatisfied were you as a nurse practicing in the virtual environment?

Demographic Questions:

16. What is your race/ethnicity?

a. White
b. Hispanic or Latino
c. Black or African American
d. Native American or American Indian
e. Asian / Pacific Islander
f. Other

17. What is your gender?

a. Male
b. Female
c. Other

18. What is your age?

a. 18-24 years old
b. 25-34 years old
c. 35-44 years old
d. 45-54 years old
e. 55-64 years old
f. 65-74 years old
g. 75 years or older

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106. Adler-Milstein, J, Raphael, K, O'Malley, TA, et al. Information sharing practices between US hospitals and skilled nursing facilities to support care transitions. JAMA network open 2021;4(1):e2033980-e2033980.

CURRICULUM VITAE

CAROL ANN MILLS

EDUCATION

Ph.D. in Health Policy and Management — August 2022
Richard M. Fairbanks School of Public Health
Indiana University, earned at Indiana University-Purdue University Indianapolis
Indianapolis, IN

Dissertation
Title: "*The Effects of Healthcare Service Disruptions on the Community, Healthcare Services and Access to Care*"
Committee Members: Justin Blackburn, MPH, PhD, Chair, Ann M. Holmes, PhD, Kathleen Unroe MD, MHA, Valerie A. Yeager, DrPH, MPhil

Master of Science in Management — 1992
University of Wisconsin-Milwaukee
Focus: Health care
Milwaukee, WI

Bachelor of Science in Nursing — 1982
University of Wisconsin-Milwaukee
Milwaukee, WI

PROFESSIONAL EXPERIENCE

Chief Executive Officer — 2003-2017
Director of Medical Management
Select Health Network, Mishawaka, IN

Manager, Central Billing Office — 2001-2003
Allied Physicians of Michiana, LLC, South Bend, IN

Director of Operations and Managed Care Services — 1996-1999
Memorial Hospital and Community Health Alliance, South Bend, Indiana

Program Director — 1994-1996
RehabCare Group, Michigan City, IN

Public Relations Director — 1991-1994
Marketing Specialist
Business Development Consultant
Trinity Regional Health System, Rock Island, IL

Program Director 1986-1989
Director of Nursing
Consultant
National Medical Enterprises, Los Angeles, CA; various sites

Education and Research RN 1984-1986
Sacred Heart Rehabilitation Hospital, Milwaukee, WI

Cardiology RN 1982-1984
Mount Sinai Medical Center, Milwaukee, WI

TEACHING EXPERIENCE

INDIANA UNIVERSITY–PURDUE UNIVERSITY INDIANAPOLIS, Indianapolis, IN
Richard M. Fairbanks School of Public Health, Department of Health Policy and Management

PBHL-H345: Operations Management and Quality Improvement in Healthcare
Course Instructor (Fall 2019, Spring 2020, Summer 2020, Fall 2020, Spring 2021, Summer 2021, Fall 2021, Spring 2022, Summer 2022)

PBHL-H245: Professionalism in the Healthcare Workplace
Course Instructor (Fall 2020)

PBHL-H320: Health Systems Administration
Teaching Assistant (Spring 2020)

Kelley School of Business, Executive MBA Program
C-580: Operations Management
Grader (Summer 2019)

UNIVERSITY OF NOTRE DAME, Notre Dame, IN
Mendoza College of Business, Department of Management

MGTO-20100: Principles Of Management
Course Instructor (Spring 2000, Fall 2000, Spring 2001)

INDIANA TECH, South Bend, IN

BA-4800: Public Relations
Course Instructor (Fall 1999)

BA-4700: Training & Development
Course Instructor (Fall 1999)

BA-1400: Principles of Management
Course Instructor (Spring 2000)

PEER REVIEWED PUBLICATIONS

Mazurenko, O., **Mills, C. A**., Bandali, E., Ballard, J. H., & Bell, T. M. (2022). Using prescription opioids throughout a traumatic injury recovery: a qualitative exploratory study of adolescents in a midwestern state. Drug and alcohol dependence, 109480.

POSTERS AND PRESENTATIONS

Mills, C. A., Tran, Y., Yeager, V.A., Unroe, K.T., Holmes, A., Blackburn, J. *Perceptions of Nurses Delivering Nursing Home Virtual Care Support: A Qualitative Pilot Study.* Poster presentation at 2022 AcademyHealth Annual Research Meeting, Washington DC, June 4-7, 2022.

Purkeypile, S., & **Mills, C. A**. (2004, May 13-14). *Case Study: Designing an Innovative Approach to Disease Management* [Conference session]. American Association of Integrated Healthcare Delivery Systems Tenth Annual Spring Managed Care Forum, New Orleans, LA, United States.

Mills, C. A., & O'Connor, S. J. (1994, November). *Childbirth and the Return to Work Decision of Hospital-Based Registered Nurses* [Paper presentation by Stephen J. O'Connor]. Southern Management Association Annual Meeting, New Orleans, LA, United States.

PROFESSIONAL SERVICE

Peer reviewed manuscript with Justin Blackburn, PhD — March 2021
American Journal of Managed Care

Session Moderator — October 2019
Collaborating Across Borders Crossroads of Collaboration Conference

UNIVERSITY SERVICE

Vice President, IUPUI Chapter AcademyHealth — 2019-2021

Team Education Advancing Collaboration in Healthcare facilitator — Spring 2021
Interprofessional Practice and Education (IPE)

Student Representative — April 2021
Richard M. Fairbanks School of Public Health Academic Misconduct Board of Appeals

Student Panelist — January 2020
Council on Education for Public Health (CEPH) accreditation survey

Student Panelist — November 2019
APHEA (Agency for Public Health Education Accreditation) survey

COMMUNITY SERVICE

American Heart Association

Board	2016-2017
Board Secretary	2016-2017
Go Red for Women Campaign, Campaign Chair	2015-2016
Executive Leadership Team	2014-2017

Habitat for Humanity Chair	2008-2012
Board	2003-2012

Honoring Choices Northern Indiana Coalition	2016-2018
Steering Committee	2017-2018

Indiana Rural Health Association, Member

St. Joseph County Health Improvement Alliance, Member

St. Joseph County Fetal Mortality Review Program, Member

AWARDS AND HONORS

Community Engagement Associate Scholar — August 2020-May 2021
IUPUI Institute for Engaged Learning

CERTIFICATIONS

Preparing Future Faculty and Professionals — September 2020

PROFESSIONAL AFFILIATIONS

AcademyHealth (Member) — 2018-present

Academy of Management (Member) — 2021-present

Indiana Rural Health Association (Member) — 2017-present