THE SYSTEMIC EFFECTS OF A STATE PSYCHIATRIC HOSPITAL WAITLIST POLICY ON MENTAL HEALTH SERVICES USE

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ABSTRACT

ELIZABETH MARIE HOLDSWORTH LA: The Systemic Effects of a State Psychiatric Hospital Waitlist Policy on Mental Health Services Use
(Under the direction of Joseph Morrissey)

In response to state psychiatric hospital bed shortages nationally, many states have implemented waitlist policies in an effort to control patient admissions and avoid operating overcrowded treatment units. While these policies allow hospitals to care for patients in a safe manner, they do nothing to address the unmet need for inpatient care. As a result, people in psychiatric crises can experience substantial delays before being admitted to a state hospital. Uncertainties remain as to whether waitlists are affecting the mental health system in ways that are not yet documented in the literature.

This dissertation used the experience of North Carolina to evaluate the systemic effects of waitlists on mental health services use. The first study used state hospital utilization data to determine possible *internal* effects of the policy on the number and case mix of admissions to state hospitals, as these hospitals were no longer able to operate over capacity and may have prioritized the sickest patients for admission from waitlists. The second and third studies used North Carolina Medicaid data to examine possible *external* effects of the policy on the frequency and length of stay of general hospital emergency department (ED) visits (statewide and regionally), as people who previously would have been admitted to state hospitals were forced to wait in communities until psychiatric beds became available.

Results from the studies indicated that waitlists were associated with fewer state hospital admissions (overall and by people with SMI), but were not associated with changes in the monthly percent of admissions by people with SMI. Waitlists were also generally associated with small increases in the frequency and length of stay of ED visits among Medicaid enrollees with severe mental illness (SMI). These findings provide preliminary evidence that the external and internal

effects of North Carolina's waitlist policies were limited. However, additional research is needed to determine whether results related to ED use extend to people who are uninsured or diagnosed with other behavioral health diagnoses. Further research is also needed to confirm that people previously cared for in state hospitals are receiving timely access to acute inpatient psychiatric care.

To Tom

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PREFACE

This dissertation is organized around three manuscripts, corresponding to the study's three specific aims. Chapter 1 serves as an introductory chapter, including a brief background, discussion of the limitations of existing literature, and an overview of the dissertation's three studies. Chapters 2, 3, and 4 are the three manuscripts. These chapters have some redundancies needed so that the papers can stand alone as separate manuscripts for publication. The dissertation concludes with Chapter 5, which offers a summary of findings, as well as a discussion of the policy implications and areas for future research. Additional details on the dissertation's three studies are provided in the Appendices.

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LIST OF ABBREVIATIONS

CCQI	Carolina Cost and Quality Initiative
CMS	Centers for Medicare and Medicaid Services
DMHDDSAS	Division of Mental Health, Developmental Disabilities and Substance Abuse Services
DSOHF	Division of State Operated Healthcare Facilities
ED	Emergency department
EMTALA	Emergency Medical Treatment and Active Labor Act
HEARTS	Healthcare Enterprise Accounts Receivable Tracking System
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
MH	Mental health
NASMHPD	National Association of State Mental Health Program Directors
PRTF	Psychiatric residential treatment facility
SA	Substance abuse
SMI	Severe mental illness
SNF	Skilled nursing facility

CHAPTER 1

INTRODUCTION

Background

State psychiatric hospitals have historically served as the mental health safety net for patients with severe mental illness (SMI). However, deinstitutionalization policies implemented by the states resulted in the closure of more than 85 percent of public psychiatric hospital beds between 1970 and 2002 (Center for Mental Health Services, 2006). These closures were only partially offset by increases in psychiatric bed capacities at local general hospitals, private psychiatric hospitals, and other mental health organizations, resulting in a net decrease in the available supply of psychiatric beds nationally. Between 1970 and 2002, the total number of psychiatric beds across all organizations decreased by nearly 60 percent (Center for Mental Health Services, 2006). Although deinstitutionalization's intent was to transform the public mental health system from a predominantly institutional, state hospital-based system to one that was largely outpatient-oriented and community-based, state psychiatric hospitals continue to play a crucial role in serving populations unable to be cared for in other settings (Davis et al., 2012; Fisher et al., 2009; Manderscheid et al., 2009).

Many observers now believe that deinstitutionalization has gone too far, resulting in a shortage of psychiatric beds in most communities (Torrey et al., 2012; Torrey et al., 2008; Tuttle, 2008; Salinsky and Loftis, 2007; National Association of State Mental Health Program Directors (NASMHPD) Research Institute, Inc., 2006; New Freedom Commission on Mental Health, 2004). Although limited information is available on the extent of these shortages, reports from a mental health advocacy group estimated that the U.S. mental health system experienced a shortage of nearly 96,000 public psychiatric beds in 2005 (Torrey et al., 2008), with the number of state hospital beds decreasing by an additional 14 percent between 2005 and 2010 (Torrey et al., 2012). By 2012, over 60% of state mental health agency directors, or 25 of 41 states responding to a national survey

conducted by NASMHPD Research Institute, Inc. (2012), indicated that their state was experiencing a shortage of psychiatric beds.

According to results from the same survey of state mental health agency directors, strategies used to deal with psychiatric bed shortages vary substantially across states (NASMHPD Research Institute, 2012). Several state mental health agencies reported that their state hospitals were overcrowded as a result of bed shortages. State agencies reported a number of actions being taken to address the shortages, including increasing inpatient capacity in the community or in state hospitals, expanding crisis services and community-based outpatient services, and facilitating state hospital discharges of patients able to return to the community.

Many states also reported using waitlists to manage excess demand for state hospital inpatient care (NASMHPD Research Institute, 2012). In total, 21 state mental health agencies reported maintaining waitlists for inpatient services, with 13 of these states indicating that waitlists for state hospital beds were *increasing* in response to psychiatric bed shortages. However, it is unclear whether these state responses indicated an increase in the number of patients placed on a waitlist for admission or the amount of time spent on waitlists. Other reports have noted long waits using both definitions, with state hospital waitlists ranging from few patients to several hundred and wait times ranging from several days to months (Keefe, 2013; Rosenthal, 2013; Dexheimer, 2012; Timmins, 2012; Torrey et al., 2012; Fender, 2011; Smith, 2011; Substance Abuse and Mental Health Services Administration, 2011; Judd, 2010; Torrey et al., 2008; Wortzel et al., 2007; Appelbaum, 2003; Draper et al., 2003).

State psychiatric hospital waitlists are a rational policy for state hospitals with limited staffing and silo mentalities. For the first time, these waitlists provided state hospitals with control over the inflow of patients. Historically, state hospitals had little control over admissions (when patients arrived and were admitted) but they had more tools to control the outflow or discharge of patients. The lack of control over admissions contributed to overcrowded conditions, undertreatment of patients, and difficulties with staff recruitment and hospital accreditation (Appelbaum, 1991).

Although state hospital waitlist policies allow these hospitals to care for patients in a safe and effective manner, they are likely affecting the mental health system in other ways not yet fully

documented in the literature. This dissertation is inspired by systems thinking (Sterman, 2000), acknowledging that the mental health system is not static with isolated service providers acting independent of each other, but rather a complex and dynamic system with many interdependencies. Policies and changes aimed at one part of the system likely have unanticipated consequences throughout the system. State hospital waitlists may be a short-sighted solution to managing excess inpatient demand if their full range of effects on the system remains unknown. Systems thinking would encourage a more holistic perspective, looking beyond the expected effects of the state hospital waitlists, for a better understanding of unintended effects both internally and externally.

Specifically, on the *internal* side, it is unclear whether waitlists have affected the number and case mix of patients admitted to state hospitals. In a parallel fashion, uncertainties also remain on the *external* side as to whether the waitlists have affected the use of general hospital emergency departments (EDs) either statewide or regionally. EDs are required under the Emergency Medical Treatment and Active Labor Act (EMTALA) to manage psychiatric patients needing inpatient care until a suitable bed becomes available in the parent hospital or another facility.

Limitations of existing research

The focus of this dissertation is unique as no prior studies have evaluated either the effects of state psychiatric hospital waitlist policies on the number and case mix of state hospital admissions or on ED use (statewide or regionally). Only one previous study has formally evaluated the effects of waitlists on mental health services use (La et al., working paper). This study found that North Carolina's post-waitlist period was associated with longer stays in the state hospitals and longer times to state hospital readmission, providing preliminary evidence that state hospitals were not discharging patients "quicker-but-sicker" post-waitlist in an effort to admit more patients from the waitlist. In addition, a recent study by North Carolina's Department of Health and Human Services (2011) evaluated ED length of stay for behavioral health crises using data from a sample of EDs in the state during November 2010, over three years after the state announced a waitlist policy. The study found that ED length of stay for people experiencing behavioral health crises were longest for people transferred to state hospitals for care (26.6 hours) as compared to people admitted to general

hospitals (14.1 hours) and people with all other dispositions (9.6 hours). However, no comparison was made to ED length of stay during a pre-waitlist time period.

Previous studies have not yet evaluated the internal effects of waitlists on the number and case mix of admissions to state hospitals. However, prior literature has evaluated the effects of state hospital bed closures on state hospital case mix during deinstitutionalization. Dorwart (1988) surveyed one state hospital in Massachusetts in 1977, immediately following a period of substantial bed reductions. He then compared the hospital's 1977 case mix to the mix ten years later; at each of the surveys the number of patients in the hospital was similar. He found that even though bed reductions occurred prior to the first survey, the case mix in the second survey was comprised of more patients who were male and involuntarily committed, and fewer patients with length of stay less than one month. These findings indicate that (1) there were changes in the absolute numbers of patients presenting to the hospitals with these characteristics and (2) there may be a lag in the effects of deinstitutionalization and bed reductions on state hospital case mix. Relative changes to state hospital case mixes were reported at two other Massachusetts state hospitals between 1977 and 1991 as well (Fisher et al., 1996). As the hospitals downsized, the proportion of patients male and with multiple admissions increased, while the proportion of patients over age 65 decreased (Fisher et al., 1996). Specific findings were not consistent across the two studies about the effects of state hospital census reduction on patient diagnostic case mix (Dorwart, 1988; Fisher et al., 1996).

Similarly, although literature examining the effects of state hospital waitlists on ED utilization does not exist, several studies during the deinstitutionalization era have examined the association between deinstitutionalization and general hospital psychiatric unit use (Cotton et al., 1979; Bassuk, 1980; Bachrach, 1981; Kiesler and Sibulkin, 1983). Two of these studies found that deinstitutionalization was associated with a higher proportion of patients in general hospital psychiatric units with prior state psychiatric hospitalizations (Cotton et al., 1979; Bassuk, 1980). The other studies by Bachrach (1981) and Kiesler and Sibulkin (1983) found that deinstitutionalization's reduced bed capacity and utilization coincided with increased utilization of general hospital psychiatric units. Results from a study by Mechanic and colleagues (1998) suggested that by 1994, general

hospitals were increasingly caring for people who would have previously been cared for in state hospitals, such as people with SMI.

Several more recent studies have examined the effects of psychiatric bed closures on patterns of ED utilization, with mixed results (Shumway et al., 2012; Little et al., 2011; Bastiampillai et al., 2010). For example, one study found no association between general hospital psychiatric unit bed reductions and increased demand for psychiatric emergency services (Shumway et al., 2012), while another study found that bed reductions were associated with fewer ED visits and decreased ED wait times for people presenting to the hospital with a psychiatric diagnosis (Bastiampillai et al., 2010). Little and colleagues (2011) found that mean length of stay in one general hospital ED was greatest in the month following closure of a nearby state psychiatric hospital. A recent study funded by the National Institute of Mental Health (Lindrooth, 2007) also sought to examine the effects of psychiatric bed closures on psychiatric admissions through EDs, although results have not yet been published.

Overview of dissertation

This dissertation offers the first statewide assessment of the effects of a state hospital waitlist policy, taking both an inward look at the effects of the waitlists on the number and types of patients admitted to state hospitals and an outward look at the effects of North Carolina's waitlists on ED utilization. Chapter 2, *Internal impact of state psychiatric hospital waitlists on the number and case mix of admissions*, uses North Carolina state hospital utilization data in a pre-/post-waitlist comparison of the number and case mix of admissions to the hospitals. This study tests two hypotheses: that the waitlists were associated with fewer state hospital admissions and a greater proportion of monthly admissions by people with SMI. The rationale is that hospitals were no longer able to operate over capacity and may have prioritized the sickest patients for admission from the waitlists. Chapter 3, *External effects of a state psychiatric hospital waitlist policy on emergency department utilization*, uses a difference-in-difference approach to evaluate North Carolina Medicaid data for people with SMI. The study tests the hypotheses that the post-waitlist period was associated with increases in (1) the probability of having any ED visits in a given month, (2) the number of ED visits in a given month, and (3) ED length of stay, as people who previously would have been

admitted to state hospitals (even when overcrowded) were forced to wait in communities until psychiatric beds became available. Chapter 4, *External effects by region of a state psychiatric hospital waitlist policy on emergency department use*, extends the research from Chapter 3, providing a more in-depth look at whether post-waitlist changes in ED utilization by Medicaid enrollees with SMI varied across North Carolina's four state hospital regions. Chapter 5, *Conclusions*, provides a summary of findings from the three empirical studies and discusses implications and areas for future research.

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CHAPTER 2

INTERNAL IMPACT OF STATE PSYCHIATRIC HOSPITAL WAITLISTS ON THE NUMBER AND CASE MIX OF ADMISSIONS

INTRODUCTION

Between 1970 and 2002, more than 85 percent of public psychiatric hospital beds were closed, as states deinstitutionalized people with mental illness and attempted to shift care to less restrictive settings (Center for Mental Health Services, 2006). However, increases in community-based psychiatric bed and outpatient service capacities did not keep pace with the closure of public psychiatric beds (Center for Mental Health Services, 2006), resulting in an overall shortage of psychiatric beds in most communities (Torrey et al., 2012; Torrey et al., 2008; Tuttle, 2008; Salinsky and Loftis, 2007; National Association of State Mental Health Program Directors (NASMHPD) Research Institute, Inc., 2006; New Freedom Commission on Mental Health, 2004). Faced with these bed shortages, many states place people on waitlists for inpatient admission if beds are not immediately available at time of referral. In 2012, 21 state mental health agency directors reported maintaining waitlists for inpatient services (NASMHPD Research Institute, 2012).

Waitlists are often used in state hospitals in particular, which have historically served as the setting of last resort for inpatient psychiatric care. Prior to waitlists, state hospitals were unable to control when patient arrivals and admissions occurred, only able to control patient outflow or discharges. The lack of control over admissions contributed to overcrowded conditions, undertreatment of patients, and difficulties with staff recruitment and hospital accreditation (Appelbaum, 1991). Waitlists provided state hospitals with control over the inflow of patients for the first time. Given the variety of services offered in state psychiatric hospitals nationally, it is not surprising that waitlists of adult patients have been reported for hospital acute short-term care, chronic long-term care, and forensic services (Keefe, 2013; Rosenthal, 2013; Dexheimer, 2012;

Timmins, 2012; Torrey et al., 2012; Fender, 2011; Smith, 2011; Substance Abuse and Mental Health Services Administration, 2011; Judd, 2010; Torrey et al., 2008; Wortzel et al., 2007; Appelbaum, 2003; Draper et al., 2003). The length of these waitlists have ranged from few patients to several hundred, with wait times reaching as high as several weeks for acute care or several months for long-term care and forensic services. While waiting, people are typically located in general hospital emergency departments (EDs), crisis facilities, jails/prisons, or the larger community (as opposed to inpatient units within general hospitals), making them subject to whatever treatments are available in those settings.

In North Carolina, capacity at the state's four psychiatric hospitals decreased by more than 30% between fiscal years 2001 and 2006, from 1,755 to 1,180 beds (White, 2012). These reductions were in large part driven by the passage of a Mental Health Reform Bill (House Bill 381 2001) aimed at downsizing the hospitals and shifting care to community settings (Swartz and Morrissey, 2003; Vicario 2012). However, decreased reliance on state hospitals for acute care did not follow; by fiscal year 2007, the state had the highest absolute number of hospital admissions as compared to all other states nationally (17,419 admissions vs. a mean of 3,203 admissions in all other reporting states) with a median length of stay of only 7 days for adults (Center for Mental Health Services, 2006).

Following a number of questionable patient deaths, attacks on staff members, and threatened loss of federal funding from Medicaid and Medicare, the state Division of Mental Health, Developmental Disabilities and Substance Abuse Services announced a state hospital waitlist policy on February 6, 2007 (Swartz and Morrissey, 2012; Coletti, 2008; Bonner 2007; Moseley, 2007). The policy was initiated to address patient and staff safety concerns as well as treatment disruptions when the hospitals were operating over capacity. The policy instructed state hospital administrators to delay patient admissions when the hospital's admission unit capacity exceeded 110%. However, actual implementation of waitlists to control admissions varied across the state's four psychiatric hospitals. Broughton (Western region) and Dix Hospitals (South Central region) began delaying admissions immediately in February 2007; John Umstead Hospital (North Central region) began delaying admissions in March 2007; and Cherry Hospital (Eastern region) did not delay any admissions until April 2008 (determined from state hospital waitlist data).

For the most part, the waitlists operate as first-in-first-out queues, where the patient who has been waiting the longest amount of time is admitted as soon as an additional bed becomes available. However, patients can be prioritized for admission based on level of acuity and referral location, with priority given to patients who are more acutely ill or are limiting the ability of their referral location to serve additional patients (meeting with state hospital administrators, September 1, 2010). Since not all patients placed on the waitlists are ultimately admitted to state hospitals, it is possible that the waitlists are internally affecting state hospital utilization in ways that are not yet documented.

Only one previous study has evaluated the effects of waitlists on state hospital utilization (La et al., working paper). That study found that the post-waitlist period was associated with longer patient length of stays and longer time to readmission, providing preliminary evidence that state hospitals are not discharging patients "quicker-but-sicker" post-waitlist in an effort to admit more patients from the waitlist. What is at yet unclear, however, is whether the number and case mix of admissions also changed and in what ways?

North Carolina has had a long tradition of using its state hospitals for acute care even after national deinstitutionalization efforts (Swartz and Morrissey, 2012). State hospital administrators note that in the past, many of these admissions were associated with substance abuse (SA) disorders and that these patients required shorter stays in the hospital prior to discharge (meeting, September 14, 2011). Given that certain patients can be prioritized for admission from waitlists, it is possible that the waitlists are filtering out these patients who are relatively easier to care for, resulting in a more severely ill case mix of admissions despite fewer admissions overall.

The central hypothesis of the current study is that the waitlist policy resulted in a greater proportion of monthly admissions by people diagnosed with severe mental illness (SMI), as hospitals were forced to be more selective about which patients were admitted (i.e., prioritizing people with SMI diagnoses for state hospital admission and allowing people with non-SMI and primary SA diagnoses to be treated elsewhere). Here, the changing case mix of admissions to state hospitals is expected to represent a *relative change*, as decreases in the number of admissions by people with non-SMI diagnoses outpaced decreases in the number of admissions by people with SMI. In contrast, the *absolute number* of admissions (overall and by diagnosis subgroups) is expected to decrease post-

waitlist as state hospitals were no longer able to operate treatment units in excess of capacity in the post-waitlist period.

In addition, the study also explores whether the waitlist policy affected the distribution of patient characteristics, including sex, age, race, insurance status, criminal involvement, and involuntary commitment status. These characteristics may be used to identify more difficult patients (or patients deemed more difficult as a result of community-based provider biases) who are less likely to find alternative care in the community post-waitlist. For example, the proportion of admissions by people who are male, non-white, uninsured, criminally involved, or involuntarily committed would be expected to increase in the post-waitlist period if these types of people are less likely to be admitted in community-based settings. Similar to the central hypothesis, the changing case mix of admissions to state hospitals is expected to represent a relative change, rather than an increase in the absolute number of admissions by certain groups of patients.

METHODS

Data

Data from North Carolina's Healthcare Enterprise Accounts Receivable Tracking System (HEARTS) were used to determine the monthly number and proportion of admissions with particular patient-level characteristics at each hospital. HEARTS is an administrative database maintained by North Carolina's Division of State Operated Healthcare Facilities (DSOHF) and contains information on all persons admitted to state hospitals, regardless of payer status. State hospital waitlist data were also used to estimate the year and month in which each hospital began operating on a waitlist. These data are collected monthly by each hospital and reported to the Division for statewide monitoring.

Several other data sources were used to control for time-varying state hospital region factors potentially affecting admissions. Data on age, gender, and racial composition of the four state hospital service regions were obtained from the U.S. Census Bureau's intercensal estimates (U.S. Census Bureau, 2010). Similarly, the Bureau of Labor Statistics provided monthly local area unemployment rates (Bureau of Labor Statistics, 2012). Annual data on alternative treatment availability, including the number of licensed psychiatrists and licensed adult beds in non-state

psychiatric hospitals by region were obtained from North Carolina's Health Professions Data System (North Carolina Health Professions Data System, 2004-2010) and State Medical Facilities Plans (North Carolina Division of Health Service Regulation, 2004-2010), respectively.

Sensitivity analyses also controlled for state psychiatric hospital bed capacity. These data were obtained from the American Hospital Association's Guides to the Health Care Field, the Centers for Medicare and Medicaid Services' Hospital Cost Reports, and North Carolina's DSOHF (AHA, 2003-2009; CMS, 2004-2009; White, 2012). All three sources were used to estimate capacity because of incomplete or erroneous data in any single source. The questionable reliability of estimates also contributed to the decision to use these data only in sensitivity analyses, as opposed to the study's main analyses. For example, the AHA Guides relied on the previous year's estimates when state hospitals did not respond to the annual survey, resulting in closed hospitals still appearing to have staffed capacity. Data from certain hospitals in CMS' Cost reports were similarly incorrect. A single measure of regional state hospital capacity was derived from the AHA Guides and Cost Reports using the source that provided the most reasonable estimate for each hospital in each year, based on author expectations. Finally, the estimates from DSOHF were only available statewide and not separately by state hospital. Linear interpolation was used to smooth capacity changes within a given year since all measures of state hospital capacity were reported annually at the end of each fiscal year.

Sample

The sample included all non-forensic short-term and long-term treatment unit admissions to any of North Carolina's state psychiatric hospitals between January 2004 and November 2010 by patients aged 18 to 64 years at time of admission. Forensic admissions are processed through the courts, with patients receiving care in separate treatment units in the state hospitals (i.e., forensic admissions were not subject to the waitlist policy and were therefore excluded from the study). The visit-level admissions data were aggregated to the state hospital-month level to reflect the monthly number of admissions and the admission case mix at each state hospital. The final sample consisted of 332 state hospital-month observations (83 monthly observations for each of the 4 hospitals).

The sample period January 2004 to November 2010 was selected because North Carolina had four distinct state hospital regions during this period, which remained relatively unchanged. Although an older hospital was replaced by a new facility in July 2008 (Biesecker, 2008a; Biesecker, 2008b), the state's consolidation from four to three state hospitals did not occur until December 2010 (Bonner, 2010). Data collected post-consolidation were excluded to rule out any competing explanations as to why the number and case mix of admissions had changed. For example, the addition or removal of counties from a state hospital's catchment area could influence the number and case mix of admissions.

Measures

Outcome variables included the number of monthly admissions overall, as well as the number and proportion of monthly state hospital admissions by patients with certain characteristics. These characteristics included sex, age, race, insurance status, criminal involvement, involuntary commitment status, and presence of an SMI diagnosis. Age was the only continuous variable, and was thus examined as mean age at time of state hospital admission (in years). Race was categorized as white, black, or other minority. Insurance status was categorized into patients with private insurance, public insurance (Medicaid only, Medicare only, or dual Medicaid/Medicare), or self-pay/uninsured. Criminal involvement was flagged based on whether patients had (1) any known current or pending legal charges or (2) a referral/arrival source or discharge destination related to the court system, law enforcement, or a correctional facility. Involuntary commitment was a binary flag based on whether patients had an involuntary mental health or SA commitment status associated with their admission. Last, SMI diagnosis was measured as a binary variable indicating whether patients had an SMI diagnosis listed anywhere in the state hospital visit record. SMI diagnoses were identified in the HEARTS data using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes corresponding to schizophrenia, bipolar disorder, major depression, or other nonorganic psychoses (295, 296, 298.0-298.1, 298.3-298.4, and 298.8-298.9). Over the study period, 14.1% of admissions with SMI had a diagnosis of major depression without any other SMI diagnoses. Sensitivity analyses excluded major depression diagnoses from the SMI definition to determine if results were sensitive to this definition. In an effort to investigate changes in admission

case mix by diagnosis in more detail, patient diagnoses were further classified into five mutually exclusive categories: SMI without SA, SMI with SA, non-SMI without SA, non-SMI with SA, and SA without any mental health diagnoses. The ICD-9-CM codes used in this classification scheme are provided in Table 2.1.

Key independent variables include a binary indicator for whether the state hospital-month observation was pre- or post-waitlist interacted with a linear time trend to examine the main effects of the waitlist policy, allowing both the regression intercept and slope to change post-waitlist. Although it is possible that waitlists were associated with an immediate change in outcomes, effects were expected to be most pronounced over time, as evidenced by a different slope post-waitlist. These dynamics were expected as waitlists continued to grow in the months following implementation/announcement, potentially limiting the ability of hospitals to accommodate all waitlisted patients and increasing the need to prioritize the most severely ill patients for admission. Interaction terms between the two post-waitlist variables and state hospital indicators were also included in analyses. These interactions were used in several models to examine whether the effects of the waitlist policy varied by hospital.

In all analyses, the post-waitlist period was defined in two ways. The first definition used the date of implementation, taking into account the differential implementation of waitlists by each hospital. Implementation date was defined as the first month when each hospital operated on a waitlist for at least five days. Prior to date of implementation, hospitals either (1) did not reach 110% capacity and did not need to operate on a waitlist at all or (2) only reached 110% capacity on fewer than 5 days and operated on a waitlist during these days. The second definition used the date the waitlist policy was announced on a statewide basis (February 6, 2007). After this date, all hospitals operated at or below 110% capacity. In this definition, the pre-waitlist period included observations from January 2004 through January 2007 and the post-waitlist period included observations from March 2007 through November 2010. Observations from February 2007 were excluded since the waitlist policy was implemented mid-month, resulting in a reduced sample size of 328 state hospital-month observations. This second definition was used since hospitals may have figured out how to reduce admissions at the time of policy announcement.

Other independent variables in regression analyses controlled for factors potentially affecting state hospital admissions, including linear time-trends as well as indicators for calendar months to control for seasonality) and time-varying state hospital region characteristics . Region characteristics included the demographic composition of the full population of state hospital region catchment areas, not just the hospital users (proportion male; proportion aged 20-29, 30-64, or 65 years and older; and proportion black, or other minority race). Age cut points were used to identify clinically-meaningful groups of state hospital users who may have different patterns of utilization (La et al., working paper). For example, age 20-29 was indicated since different patterns of hospital use were expected from young adults. Additional regional control variables included unemployment rate, as well as measures of available mental health services within the region (number of licensed psychiatrists per 100,000 population and number of licensed adult psychiatric beds in general hospital psychiatric units or private psychiatric hospitals per 100,000 population).

Analysis

Descriptive and time-trend analyses were used to compare monthly admissions pre- and post-waitlist, with subgroup analyses by the patient characteristics already described. Six state hospital-level fixed effects models with robust standard errors were estimated to further examine the effect of the waitlist policy on the overall number of admissions, as well as the number and proportion of admissions by people with SMI. For ease of interpretation, these models were run with and without hospital x post-waitlist interaction terms. In all models, dependent variables were modeled as continuous variables; no models produced any out of range predictions (i.e., numbers of admissions that were negative or proportions that were outside of the 0-1 range). Fixed effects controlled for observed and unobserved time-invariant regional and state hospital-level characteristics that may affect hospital use; additional control variables were used to adjust for time-varying characteristics.

Four sensitivity analyses examined whether results were robust to various model specifications. The first two of these analyses included control variables for state hospital capacity (statewide and by state hospital region). The third sensitivity analysis excluded major depression from the definition of SMI diagnoses. The fourth sensitivity analysis excluded rarely changing control variables since fixed effects models are inefficient at estimating the effects of near time-invariant

variables (Plumper and Troeger, 2007). Using a between/within variation ratio threshold of 2.8 for excluding variables (Plumper and Troeger, 2007), the model excluded most regional demographic composition variables, with the exception of the proportion of the state hospital region's full population that is classified as other minority. The model also excluded the number of licensed psychiatrists per 100,000 population as a rarely changing variable. Since the other studies in this dissertation used data from North Carolina's Medicaid population, an additional sensitivity analysis focused on the number and case mix of admissions to state hospitals for Medicaid enrollees only (Appendix A).

All analyses were conducted using Stata version 12.1 (College Station, Texas) with alpha level of 0.05. The study was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill.

RESULTS

Between January 1, 2004 and November 30, 2010, there were 72,035 non-forensic adult admissions to North Carolina's state hospitals. Table 2.2 displays the mean absolute number of monthly admissions pre- and post-waitlist. In both the pre- and post-waitlist periods, the majority of monthly state hospital admissions were for patients who were male, white, self-pay or uninsured, without criminal involvement, involuntarily committed, and diagnosed with SMI.

Following waitlist policy implementation, the mean absolute number of monthly state hospital admissions decreased by 46.4% (from 281.0 to 150.6 admissions, $p<0.001$). These reductions varied by hospital, ranging from a mean of 39.2% to 60.2% fewer monthly admissions post-waitlist at Dix Hospital and Cherry Hospital, respectively (all statistically significant at $p<0.001$). The mean absolute number of monthly state hospital admissions decreased post-waitlist across all subgroups analyzed. For example, the mean number of monthly admissions by people with SMI decreased by 42.0% (from 165.8 to 96.1 admissions, $p<0.001$). Similar results were found when the post-waitlist period was defined based on date of policy announcement. However, from Table 2.2, it should be noted that Cherry hospital had a lower mean number of monthly admissions post-waitlist based on date of implementation vs. date of policy announcement (109.9 vs. 143.0, respectively).

Based on clinical significance, the distribution of patient characteristics remained for the most part unchanged across policy periods (Table 2.3). The two exceptions were patient insurance status

and SMI diagnosis, which changed post-waitlist by at least ten percentage points. In unadjusted results, the percent of state hospital admissions by people who were self-pay/uninsured decreased from 57.6% pre-waitlist to 47.3% post-waitlist ($p<0.001$) based on date of implementation, with similar results based on date of policy announcement. This shift was mostly offset by increases in the percent of admissions by people with Medicaid only (16.8% pre-waitlist vs. 23.0% post-waitlist, $p<0.001$) or dual Medicaid/Medicare (11.8% pre-waitlist vs. 13.9% post-waitlist, $p<0.001$). However, a closer look at the distribution of insurance status over time (Figure 2.1) shows that these changes may, at least partially, reflect general trends over the full study period. Between 2004 and 2010, the percent of North Carolina residents with public insurance increased from 28.8% to 34.3% (U.S. Census Bureau, 2011). Regression models formally tested whether the waitlists were associated with changes in the number and case mix of admissions by insurance status. Results from these models (not shown) indicated that waitlist implementation was associated with an average 27.9 fewer monthly admissions by people who were uninsured or self-pay across all post-waitlist months ($p<0.001$) but no incremental effect over the estimated effect from each prior month. Waitlist implementation was also associated with an average 3.3% *increase* in the percent of monthly admissions by people who were uninsured or self-pay across all post-waitlist months ($p=0.007$) but no incremental effect in each additional month post-waitlist. In contrast, the model's linear time trend was associated with a 0.3% decrease in the percent of admissions by people who were uninsured or self-pay in each month over the full study period ($p<0.001$).

The unadjusted average percent of monthly admissions by people diagnosed with SMI increased post-waitlist implementation by 10.2 percentage points (59.7% pre-waitlist vs. 69.9% post-waitlist, for a relative increase of 17.1%, $p<0.001$). This increase varied by state hospital, ranging from a 7.9 percentage point increase at Dix Hospital to a 15.3 percentage point increase at Cherry Hospital (all statistically significant at $p<0.001$). The time-series plot in Figure 2.2 shows a relatively flat trend pre-waitlist implementation for most hospitals (with the exception of Cherry Hospital), followed by an increase in the proportion of admissions by people with SMI. A closer look at the mix of admissions by patient diagnoses reveals that the increase in the percent of admissions by people with SMI was dominated by people with SMI *and* SA (25.3% pre-waitlist vs. 33.6% post-waitlist,

p<0.001) as opposed to people without comorbid SA. The corresponding decrease in the percent of monthly admissions by people with non-SMI diagnoses was driven by people with SA alone (13.2% pre-waitlist vs. 7.0% post-waitlist, p<0.001). Again, results were consistent when the post-waitlist period was defined based on date of policy announcement.

For the most part, regression results (Table 2.4) indicate that the waitlist policy was associated with a decrease in the *absolute number* of admissions overall and by people with SMI. In models excluding state hospital x post-waitlist interaction terms, waitlist implementation was associated with an average 53.1 fewer total monthly admissions across all months post-waitlist (p<0.001) and an incremental 1.6 fewer total monthly admissions in each additional month post-waitlist (p=0.01). For example, in month zero post-waitlist, the expected effect of the waitlist is -53.1 admissions; in month one post-waitlist, the expected effect of the waitlist is -54.7 admissions (-53.1-1.6=-54.7). The magnitudes of these overall effects were even larger when the post-waitlist period was defined based on date of policy announcement. Waitlist announcement was associated with an average 56.0 fewer total monthly admissions across all months post-waitlist (p<0.001) and an incremental 3.4 fewer total monthly admissions in each additional month post-waitlist (p<0.001). Waitlists were also associated with a decrease in the number of admissions by people with SMI. Specifically, waitlist implementation was associated with an average 31.8 fewer monthly admissions by people with SMI across all months post-waitlist (p<0.001) and an incremental 1.4 fewer monthly admissions by people with SMI in each additional month post-waitlist (p<0.001). Again, the effect sizes were larger when the post-waitlist period was defined based on date of policy announcement (-33.3 and -2.2, respectively, both at p<0.001).

As shown in results from models including state hospital x post-waitlist interaction effects, the effects of waitlists on the number of admissions overall and by people with SMI differed by state hospital (all main and interaction effects were jointly significant at p<0.001). For example, at Central Regional Hospital, waitlist implementation was not associated with a statistically significant change in average number of monthly admissions overall or by people with SMI across all months post-waitlist, although each additional month post-waitlist was associated with an incremental 3.1 fewer admissions overall and 2.2 fewer admissions by people with SMI (both at p<0.001, as seen by the

effects of the interaction between the post-waitlist and linear time trend variables). Post-waitlist effects for the other three hospitals are calculated by adding each hospital's interaction effect to the main effect. For example, at Broughton hospital, the waitlist policy was associated with an average 49.6 fewer overall monthly admissions across all months post-waitlist ([-12.1] + [-37.5] = -49.6, $p<0.01$) and an incremental 1.5 fewer admissions for each additional month post-waitlist ([-3.1] + [1.6] = -1.5, $p<0.001$). Based on these calculations, the effects of waitlist implementation across all months post-waitlist ranged from no difference in average number of monthly admissions overall or by people with SMI at Central Regional Hospital to 92.1 fewer monthly admissions overall and 57.0 fewer monthly admissions by people with SMI at Cherry Hospital ($p<0.001$). Similarly, the incremental effects of each additional month post-waitlist implementation ranged from 3.3 *more* admissions overall and 1.3 *more* admissions by people with SMI at Cherry Hospital (both at $p<0.001$) to 3.1 fewer admissions overall at Central Regional ($p<0.001$) and 2.2 fewer admissions by people with SMI at Central Regional and Dix ($p<0.001$). Cherry Hospital was the only hospital that had more admissions expected for each additional month post-waitlist implementation. However, Cherry Hospital's results based on date of policy announcement indicate that each additional month post-waitlist was associated with 1.2 fewer admissions overall and 0.7 fewer admissions by people with SMI (both jointly significant at $p<0.001$), suggesting that the hospital may have started limiting admissions at time of policy announcement without operating on a waitlist. All other results defining the post-waitlist period based on date of policy announcement were consistent, although the magnitudes of the effects were generally larger as compared to results defining the post-waitlist period based on date of waitlist implementation.

Contrary to the study's hypotheses, the waitlist policy was not associated with a statistically significant increase in the percent of admissions by people with SMI, even though there was a 10.2 percentage point difference in this statistic across the two policy periods (59.7% of admissions by people with SMI pre-waitlist vs. 69.9% post-waitlist, $p<0.001$). Full regression results from the study's main models are provided in Appendix A.

Results from sensitivity analyses were generally consistent with those from the main analysis (Table 2.5). Across all sensitivity analyses, waitlists were associated with decreases in the number of

admissions overall and by people with SMI, although the magnitude of these effects varied to some extent across analyses. Waitlists were also consistently not associated with a change in the percent of admissions by people with SMI. These findings held, regardless of whether the post-waitlist period was defined based on date of waitlist implementation or policy announcement.

DISCUSSION

Results confirm the hypothesis that waitlists help to limit the number of state hospital admissions. In unadjusted results, the average number of monthly admissions decreased 46.4% after waitlist implementation. These reductions occurred overall, as well as across all patient subgroups analyzed, suggesting that no subgroups were immune to the policy's effects on reducing admissions. Results from regression models confirmed that waitlist policy implementation and announcement were both associated with reduced numbers of admissions overall as well as by people with SMI. At five years post-waitlist announcement, the expected effects of the policy translate to an average 260 fewer monthly admissions overall and 165 fewer monthly admissions by people with SMI as compared to pre-waitlist in each of the state hospitals. Assuming that demand for inpatient psychiatric care has remained constant over the study period, these are patients who previously would have been cared for in state hospitals but now must find care in alternate settings.

The fact that reductions in monthly admissions were larger when the post-waitlist period was defined based on date of policy announcement, particularly for Cherry Hospital, suggests that hospitals may have started limiting admissions when the policy was announced even if waitlists were not yet being used. State hospital capacity reductions occurring between the time of waitlist announcement and implementation could also help to explain these findings, as sensitivity analyses that controlled for state hospital capacity found smaller differences in effects based on the two post-waitlist specifications.

Although the waitlist policy served to manage the number of monthly admissions, waitlists were not associated with a change in the percent of admissions by people with SMI. These findings suggest that there may be factors other than the waitlists that are driving changes to the admissions case mix. For example, full regression results from the study found that increases in the share of state hospital region populations who were young adults or non-black minorities were associated with

increases in the proportion of admissions by people with SMI. Increases in the number of psychiatrists per 100,000 population were also associated with increases in the proportion of admissions by people with SMI. Although this finding related to psychiatrists is somewhat counterintuitive, it is possible that psychiatrists are more densely located in areas with higher proportions of people with SMI in general.

Limitations should be taken into account when interpreting these results. Since the waitlist policy was implemented statewide, this study lacks a control group of state hospitals in North Carolina not affected by the policy. It is possible that other changes to the mental health system may have occurred around the same time as the waitlist policy and also affected state hospital utilization. In an effort to rule out these other possibilities, the post-waitlist period was defined based on date of policy implementation, as well as date of policy announcement. Analyses also controlled for time-varying characteristics of the regions served by the state hospitals and used fixed effects to control for time-invariant factors that might affect outcomes of interest. In addition, control variables were included in analyses to capture factors potentially correlated with both the key independent variables and dependent variables. Analyses were unable to control for certain measures, such as the regional capacity of psychiatric crisis facilities, mobile crisis units, and assertive community treatment teams, due to a lack of time series data on these measures. However, analyses did control for the number of psychiatrists within each region, which may fluctuate based on the capacities of these specialized psychiatric services.

CONCLUSIONS

Many states continue to rely on state psychiatric hospitals for acute inpatient psychiatric care, as evidenced by high numbers of admissions and short length of stays (Center for Mental Health Services, 2011). This continued use of state hospitals, coupled with substantial cuts to state mental health budgets over the past several years and resulting inpatient capacity decreases (Lutterman, 2010; National Alliance on Mental Illness, 2011), indicate that patient delays will likely persist until efforts are made to “right-size” state hospitals. Evaluating the effects of these delays and their underlying policies from a systems perspective (i.e., considering both the intended and unintended consequences across patients and service providers) is needed to ensure that patients receive

quality mental health care in a timely manner without overburdening particular service providers. Based on results from the current study, waitlists are associated with fewer admissions overall and by people with SMI, but are not associated with increases in the proportion of admissions by people with SMI. Additional research is needed to determine whether people previously served in state hospitals are receiving adequate care in other settings and not increasingly turning to general hospital EDs for care during the post-waitlist period. Similarly, policy makers and state hospital administrators should be attentive to general changes in the case mix of admissions over time. Although not linked to waitlists, the current study found that there was an increase in the proportion of monthly state hospital admissions by people with SMI between 2004 and 2010, which may have implications on the number of resources needed per patient to serve the increasingly severe case mix of admissions. Future research should evaluate changes in admission case mix using other measures of patient acuity, although these measures are likely not available in administrative claims data and may be difficult to determine from retrospective chart reviews.

Table 2.1: ICD-9-CM codes used to define types of behavioral health diagnoses

Diagnosis Type	ICD-9-CM Codes
Severe mental illness (SMI) without substance abuse (SA)	At least one of [295, 296, 298 (excluding 298.2)] AND none of [291, 292, or 303-305]
SMI with SA	At least one of [295, 296, 298 (excluding 298.2)] AND at least one of [291, 292, or 303-305]
Non-SMI without SA	At least one of [290, 293-294, 297, 298.2, 299-302, 306-316] AND none of [291, 292, or 303-305]
Non-SMI with SA	At least one of [290, 293-294, 297, 298.2, 299-302, 306-316] AND at least one of [291, 292, or 303-305]
SA alone	At least one of [291, 292, or 303-305] and none of [290, 293-302, 306-316]

Table 2.2: Mean number of monthly admissions to North Carolina state psychiatric hospitals pre- and post-waitlist between January 2004 and November 2010

Subgroup	Defining post-waitlist period based on date of policy implementation (n=332)			Defining post-waitlist period based on date of policy announcement (n=328)		
	Pre-waitlist	Post-waitlist	% change (unadjusted) (p-value)	Pre-waitlist	Post-waitlist	% change (unadjusted) (p-value)
Statewide	281.0	150.6	-46.4% (p<0.001)	285.7	159.8	-44.1% (p<0.001)
By hospital						
Broughton	280.7	146.6	-47.8% (p<0.001)	280.7	144.6	-48.5% (p<0.001)
Cherry	276.2	109.9	-60.2% (p<0.001)	295.6	143.0	-51.6% (p<0.001)
John Umstead/Central Regional	291.4	167.9	-42.4% (p<0.001)	293.0	176.1	-39.9% (p<0.001)
Dix	276.7	168.3	-39.2% (p<0.001)	273.6	175.4	-35.9% (p<0.001)
By patient subgroups						
Sex						
Male	178.7	93.6	-47.6% (p<0.001)	181.2	100.1	-44.8% (p<0.001)
Female	102.3	57.0	-44.3% (p<0.001)	104.5	59.6	-43.0% (p<0.001)
Race						
White	161.5	84.7	-47.6% (p<0.001)	166.4	88.2	-47.0% (p<0.001)
Black	108.2	58.7	-45.7% (p<0.001)	107.9	64.0	-40.7% (p<0.001)
Other	11.3	7.2	-36.3% (p<0.001)	11.4	7.6	-33.3% (p<0.001)
Insurance status						
Private insurance	18.1	11.9	-34.3% (p<0.001)	18.0	12.6	-30.0% (p<0.001)
Public insurance, no private						
Medicaid only	46.9	32.8	-30.1% (p<0.001)	46.7	34.3	-26.6% (p<0.001)
Medicare only	20.7	11.6	-44.0% (p<0.001)	21.1	12.2	-42.2% (p<0.001)
Dual Medicaid/Medicare	32.9	20.1	-38.9% (p<0.001)	32.7	21.5	-34.3% (p<0.001)
Self-pay/uninsured	162.5	74.2	-54.3% (p<0.001)	167.1	79.3	-52.5% (p<0.001)
Criminal involvement						
Yes	27.0	15.4	-43.0% (p<0.001)	27.2	16.4	-39.7% (p<0.001)
No	254.0	135.2	-46.8% (p<0.001)	258.6	143.4	-44.5% (p<0.001)
Commitment status						
Involuntary commitment	257.2	131.3	-49.0% (p<0.001)	260.3	141.3	-45.7% (p<0.001)
Voluntary commitment	23.8	19.3	-18.9% (p=0.02)	25.4	18.5	-27.2% (p=0.001)
Diagnosis[a]						
SMI without SA	95.9	52.4	-45.4% (p<0.001)	97.7	55.3	-43.4% (p<0.001)
SMI with SA	71.2	49.3	-30.8% (p<0.001)	71.0	51.7	-27.2% (p<0.001)
Non-SMI without SA	28.1	12.1	-56.9% (p<0.001)	29.2	12.9	-55.8% (p<0.001)
Non-SMI with SA	48.4	25.0	-48.3% (p<0.001)	50.0	26.0	-48.0% (p<0.001)
SA with no mental health diagnosis	37.5	11.8	-68.5% (p<0.001)	37.9	13.9	-63.3% (p<0.001)

Notes:

[a] Mean number of monthly admissions by people with SMI decreased from 165.8 pre-waitlist to 96.1 post-waitlist (-42.0%, p<0.001) based on date of waitlist implementation; mean number of monthly admissions by people with SMI decreased from 168.7 pre-waitlist to 107.0 post-waitlist (-36.6%, p<0.001) based on date of policy announcement.

Table 2.3: Mean percent of monthly admissions with given characteristics to North Carolina state psychiatric hospitals pre- and post-waitlist between January 2004 and November 2010

Subgroup[a]	Defining post-waitlist period based on date of policy implementation (n=332)			Defining post-waitlist period based on date of policy announcement (n=328)		
	Pre-waitlist	Post-waitlist	% change (p-value)	Pre-waitlist	Post-waitlist	% change (p-value)
Sex						
Male	63.6	61.7	-3.0% (p=0.005)	63.4	62.1	-2.1% (p=0.05)
Female	36.4	38.3	5.2% (p=0.005)	36.6	37.9	3.6% (p=0.05)
Race						
White	57.4	56.0	-2.4% (p=0.28)	58.3	55.3	-5.1% (p=0.02)
Black	38.6	39.2	1.6% (p=0.60)	37.7	39.9	5.8% (p=0.06)
Other	4.0	4.8	20.0% (p=0.002)	4.0	4.7	17.5% (p<0.001)
Insurance status						
Private insurance	6.5	7.8	20.0% (p<0.001)	6.4	7.8	21.9% (p<0.001)
Public insurance, no private						
Medicaid only	16.8	23.0	36.9% (p<0.001)	16.4	22.7	38.4% (p<0.001)
Medicare only	7.4	8.0	8.1% (p=0.02)	7.4	8.0	8.1% (p=0.02)
Dual Medicaid/Medicare	11.8	13.9	17.8% (p<0.001)	11.5	14.0	21.7% (p<0.001)
Self-pay/uninsured	57.6	47.3	-17.9% (p<0.001)	58.4	47.6	-18.5% (p<0.001)
Criminal involvement						
Yes	9.8	11.4	16.3% (p=0.03)	9.6	11.4	18.8% (p=0.01)
No	90.2	88.6	-1.8% (p=0.03)	90.4	88.6	-2.0% (p=0.01)
Commitment status						
Involuntary commitment	91.5	85.7	-6.3% (p<0.001)	91.0	86.7	-4.7% (p<0.001)
Voluntary commitment	8.5	14.3	68.2% (p<0.001)	9.0	13.3	47.8% (p<0.001)
Diagnosis[b]						
SMI without SA	34.4	36.3	5.5% (p=0.10)	34.4	36.2	5.2% (p=0.11)
SMI with SA	25.3	33.6	32.8% (p<0.001)	24.7	33.2	34.4% (p<0.001)
Non-SMI without SA	10.0	7.6	-24.0% (p<0.001)	10.3	7.6	-26.2% (p<0.001)
Non-SMI with SA	17.1	15.5	-9.4% (p=0.003)	17.5	15.3	-12.6% (p<0.001)
SA with no mental health diagnosis	13.2	7.0	-47.0% (p<0.001)	13.1	7.6	-42.0% (p<0.001)

Notes:

[a] In addition to the subgroups listed, changes in mean age of admissions were also examined. Mean age of monthly admissions increased from 36.5 years pre-waitlist to 37.4 years post-waitlist (2.5% change, p<0.001) based on date of waitlist implementation; mean age increased from 36.6 years pre-waitlist to 37.2 years post-waitlist (1.6% change, p<0.001) based on date of policy announcement.

[b] Mean percent of monthly admissions by people with SMI increased from 59.7% pre-waitlist to 69.9% post-waitlist (17.1% change, p<0.001) based on date of waitlist implementation; mean percent of monthly admissions by people with SMI increased from 59.1% pre-waitlist to 69.4% post-waitlist (17.2% change, p<0.001) based on date of policy announcement.

Table 2.4: State hospital-level fixed effects regression estimates of the effect of the waitlist policy on the number and case mix of monthly admissions

Variable[a]	Defining post-waitlist period based on date of policy implementation (n=332)			Defining post-waitlist period based on date of policy announcement (n=328)		
	Total number of admissions	Number of admissions with SMI	Percent of admissions with SMI	Total number of admissions	Number of admissions with SMI	Percent of admissions with SMI
Models excluding hospital interaction effects						
Post-waitlist (reference: pre-waitlist)	-53.1***	-31.8***	-0.4	-56.0***	-33.3***	-0.6
Time trend * post-waitlist	-1.6*	-1.4***	0.0	-3.4***	-2.2***	0.2
Models including hospital interaction effects						
Post-waitlist (reference: pre-waitlist)	-12.1	-2.5	-0.2	-28.1*	-18.3	-2.7
Time trend * post-waitlist	-3.1***	-2.2***	0.1	-4.0***	-2.4***	0.2
Post-waitlist interaction effects						
Post-waitlist * hospital						
Post-waitlist * Broughton	-37.5**	-30.2***	-0.3	-39.1*	-28.7**	1.2
Post-waitlist * Cherry	-80.0***	-54.5***	1.2	-56.1***	-16.8	7.1**
Post-waitlist * Dix	-18.2	-15.1	0.4	2.2	-11.4	-3.3
Time trend * post-waitlist * hospital						
Time trend * post-waitlist * Broughton	1.6**	0.6	-0.2	2.1***	1.0**	-0.2
Time trend * post-waitlist * Cherry	6.4***	3.5***	0.0	2.8*	1.7	0.2
Time trend * post-waitlist * Dix	0.3	0.0	-0.2	-0.7	-0.3	0.0

* p<0.05
** p<0.01
*** p<0.001

Notes:

[a] Other independent variables controlled for time trends (linear time trend and calendar month), demographic composition of the population (sex, age, and race), regional unemployment rate, and mental health services within regions (number of licensed psychiatrists per 100,000 population and number of licensed adult psychiatric beds in general hospital psychiatric units or private psychiatric hospitals per 100,000 population).

Table 2.5: Sensitivity analysis state hospital-level fixed effects regression results estimating the effects of the waitlist policy on the number and case mix of monthly admissions

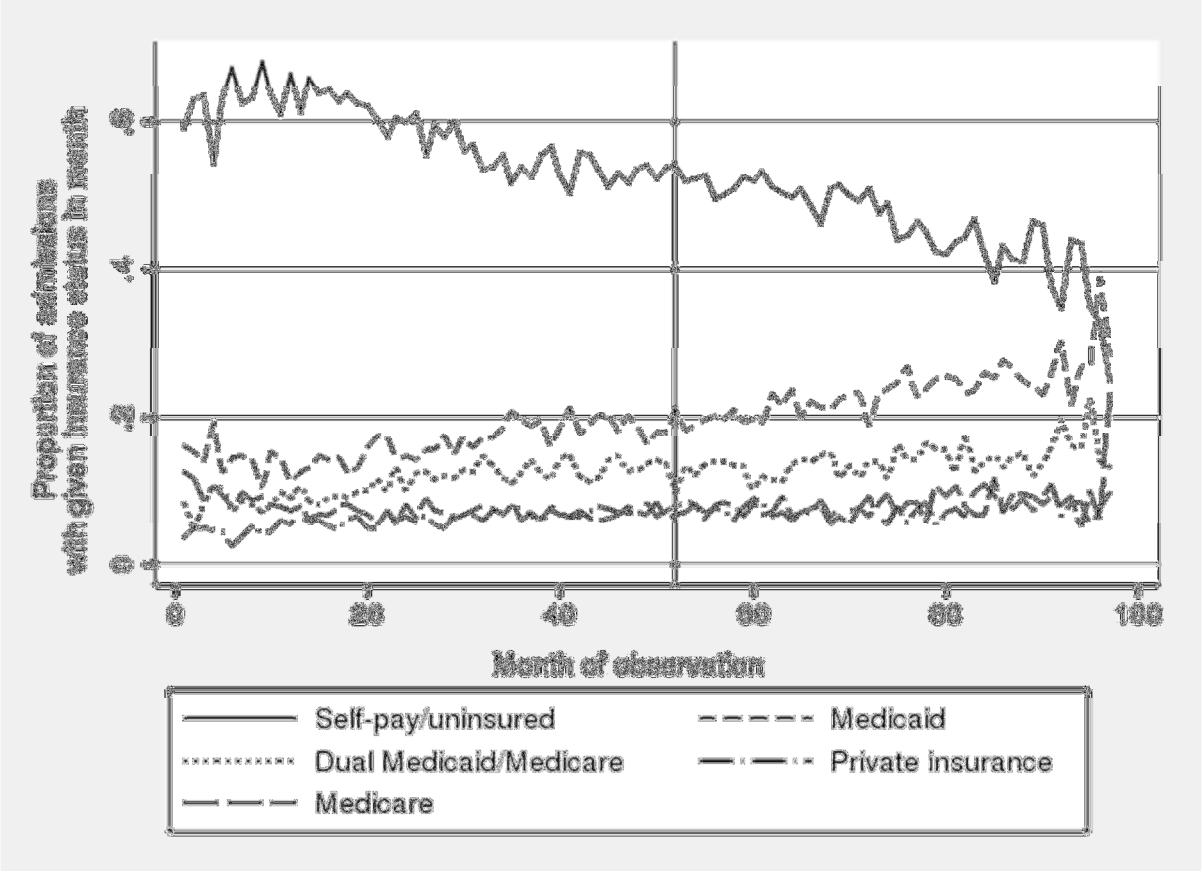
Analysis scenario and key variable[a]	Defining post-waitlist period based on date of policy implementation (n=332)			Defining post-waitlist period based on date of policy announcement (n=328)		
	Total number of admissions	Number of admissions with SMI	Percent of admissions with SMI	Total number of admissions	Number of admissions with SMI	Percent of admissions with SMI
Sensitivity analysis 1: including statewide psychiatric beds in state hospitals per 100,000 population as control variable						
Post-waitlist (reference: pre-waitlist)	-35.5***	-21.0***	-0.3	-33.9**	-18.2**	0.4
Time trend * post-waitlist	-1.6**	-1.4***	0.0	-3.2***	-2.0***	0.2
Sensitivity analysis 2: including regional psychiatric beds in state hospitals per 100,000 population as control variable						
Post-waitlist (reference: pre-waitlist)	-51.1***	-31.0***	-0.7	-54.6***	-32.7***	-0.8
Time trend * post-waitlist	-1.6*	-1.4***	0.0	-3.3***	-2.1***	0.2
Sensitivity analysis 3: excluding major depression from SMI definition						
Post-waitlist (reference: pre-waitlist)	--	-27.9***	-0.5	--	-27.7***	-0.8
Time trend * post-waitlist	--	-1.3***	0.1	--	-2.0***	0.2
Sensitivity analysis 4: excluding rarely changing control variables						
Post-waitlist (reference: pre-waitlist)	-35.1***	-23.5***	-1.1	-35.5***	-23.8***	-1.2
Time trend * post-waitlist	-2.1***	-1.6***	0.0	-4.1***	-2.6***	0.1

* p<0.05
** p<0.01
*** p<0.001

Notes:

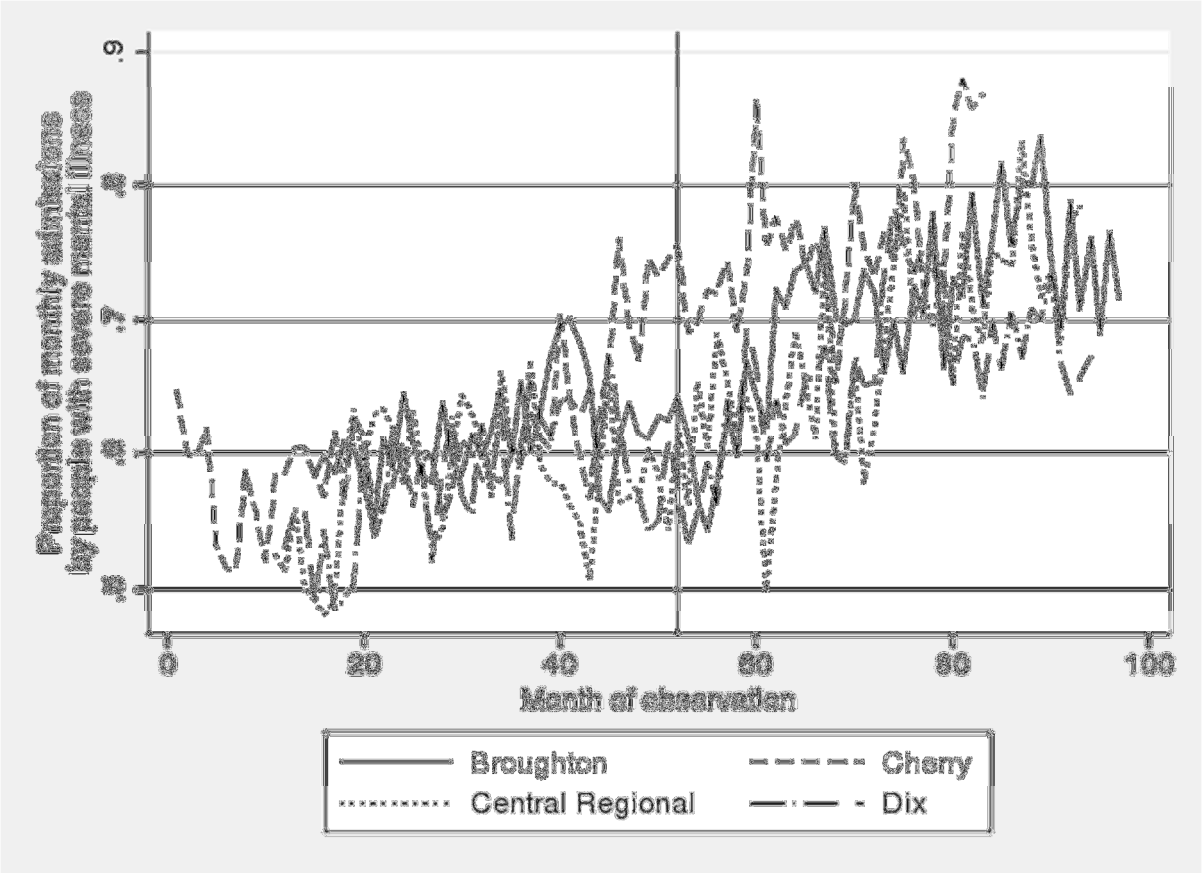
[a] Unless otherwise noted, additional independent variables controlled for time trends (number of months in the full data period and calendar month), demographic composition of the population (sex, age, and race), regional unemployment rate, and mental health services within regions (number of licensed psychiatrists per 100,000 population and number of licensed adult psychiatric beds in general hospital psychiatric units or private psychiatric hospitals per 100,000 population).

Figure 2.1: Time series plot of the distribution of admissions by insurance status



Notes: Vertical line at month 52 indicates month of statewide waitlist policy *implementation* (start and end of time series only contains data from certain state hospital regions; see Appendix A for more details). Time series plot defining post-waitlist period based on date of policy *announcement* was similar (not shown).

Figure 2.2: Time series plot of the proportion of monthly admissions by people with severe mental illness, by state hospital



Note: Vertical line at month 52 indicates month of statewide waitlist policy *implementation* (start and end of time series only contains data from certain state hospital regions; see Appendix A for more details). Time series plot defining post-waitlist period based on date of policy *announcement* was similar (not shown).

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CHAPTER 3

EXTERNAL EFFECTS OF A STATE PSYCHIATRIC HOSPITAL WAITLIST POLICY ON EMERGENCY DEPARTMENT UTILIZATION

INTRODUCTION

Shifting policies and forces in today's mental health services environment have combined to place general hospital emergency departments (EDs) at the center of community responses to psychiatric crises in addition to their role in medical trauma and urgent care. EDs have become the main evaluation and dispatch center guiding people in crisis to more intensive levels of psychiatric care. For a long time, EDs have served as a conduit to state psychiatric hospital care pretty much in a one-way manner, with the ED on the sending end and the state hospital on the receiving end. More recently, the growing shortage of psychiatric beds and associated management policies have altered this one-way relationship, converting it instead into a mutual relationship whereby what is happening at state hospitals can have major impacts on the case mix and utilization of EDs and vice versa with regard to the impact of EDs on state hospitals.

In several states, people in acute psychiatric crisis can wait for days, weeks, or even months before being admitted to a state psychiatric hospital (Keefe, 2013; Rosenthal, 2013; Timmins, 2012; Torrey et al., 2012; Judd, 2010; Torrey et al., 2008). Three main factors have contributed to these conditions. First, state psychiatric hospitals have continued to downsize, even in recent years, resulting in substantial state hospital bed shortages nationally (Torrey et al., 2012; Lutterman, 2012; Torrey et al., 2008; Center for Mental Health Services, 2006). Second, demand for state hospitals has remained high, despite efforts to shift care to community-based settings (Davis et al., 2012; Fisher et al., 2009; Manderscheid et al., 2009). And third, state hospitals have implemented waitlist policies to avoid operating over staffed capacity (NASMHPD Research Institute, 2012; Appelbaum, 1991). By 2012, 21 state mental health agencies reported using waitlists for inpatient services,

although it is unclear when these policies were initiated (NASMHPD Research Institute, 2012). Prior to implementing waitlists, state hospitals had few tools to control patient admissions, resulting in overcrowded treatment units, unsatisfactory treatment of patients, and difficulties recruiting staff and maintaining hospital accreditation (Appelbaum, 1991).

Although state hospital waitlist policies allow hospitals to limit admissions so that adequate psychiatric care can be provided, waitlists fail to address the needs associated with excess demand. Waitlists may be a short-sighted solution from a systems perspective, shifting the burden to provide inpatient psychiatric care to other agencies within the mental health system. Unable to receive immediate admission to state hospitals, many people in need of care may find themselves in locations ill-equipped to provide acute psychiatric services, such as jails, prisons, and EDs. These locations face the same problems that state hospitals once faced, in that they are unable to control inflows of mental health and substance abuse patients. Within EDs, the Emergency Medical Treatment and Active Labor Act (EMTALA) prohibits EDs from turning away patients in psychiatric crisis, regardless of ability to pay. EDs must stabilize these patients prior to discharge or transfer them to inpatient beds for further treatment, in many cases forcing EDs to rely on inpatient units or facilities to admit their patients.

In 2007, an estimated 12 million visits to general hospital EDs, or 12.5% of all ED visits nationally, included a mental health or substance abuse diagnosis (Owens et al., 2010). These patients tend to have longer ED stays than patients presenting to EDs with other diagnoses, particularly when inpatient admission is needed (Chakravarthy et al., 2013; Nicks and Manthey, 2012; Slade et al., 2010). In a 2010 survey of ED administrators, 70% reported that mental health and substance abuse patients were “boarded” in EDs for 24 hours or longer after the decision to admit the patients were made; 10% reported boarding these patients for over one week (Schumacher Group, 2010).

Given the additional strain that psychiatric patients place on general hospital EDs (Zun, 2012; Tuttle, 2008), research is needed to determine the extent to which changes in the larger mental health system are affecting use of EDs. Although several recent studies have examined the impact of psychiatric bed closures on patterns of ED utilization (Shumway et al., 2012; Little et al., 2011;

Bastiampillai et al., 2010; Lindrooth, 2007), no previous studies have assessed the effects of state hospital waitlists on ED utilization. The two studies that examined state hospital waitlists focused only on their internal effects on state hospital utilization, finding that waitlists were associated with increases in length of stay and time to readmission at the patient-level, as well as decreases in the number of admissions overall and by people with severe mental illness (SMI) at the hospital-level (both studies by La et al., working papers). Although fewer people with SMI are receiving care in state hospitals post-waitlist, uncertainties remain as to whether these people are increasingly turning to EDs for care.

The experience of North Carolina provides an opportunity to fill this gap in the literature. In 2001, the state passed a Mental Health Reform Bill (House Bill 381, 2001), which sought to downsize state psychiatric hospitals and shift care to community-based settings (Swartz and Morrissey, 2003; Vicario 2012). The bill succeeded in downsizing the state hospitals; between fiscal years 2001 and 2006, capacity at the state's four psychiatric hospitals decreased by more than 30% (White, 2012). However, by fiscal year 2007, the state still had the highest absolute number of state hospital admissions nationally (17,419 vs. an average of only 3,203 admissions across all other reporting states) and one of the highest rates of admission after adjusting for population (196.7 admissions per 100,000 population vs. an average of 57.7 admissions per 100,000 population), reflecting a continued reliance on the hospitals for short-term acute psychiatric care (Center for Mental Health Services, 2007).

On February 6, 2007, the state's Division of Mental Health, Developmental Disabilities and Substance Abuse Services announced a state hospital waitlist policy (Bonner 2007; Moseley, 2007). The policy was initiated in response to general concerns about the levels of treatment and safety provided when the hospitals were operating over capacity, as well as threatened loss of federal funding from the Centers for Medicare and Medicaid Services following cited incidents at the hospitals (Swartz and Morrissey, 2012; Coletti, 2008). Although the policy was announced statewide on the same date, state hospital waitlist data indicate that implementation of waitlists varied substantially across hospitals. Hospitals in the Western and South Central regions of the state began delaying

admissions immediately in February 2007. The hospitals in the North Central and Eastern regions of the state began delaying admissions in March 2007 and April 2008, respectively.

Following waitlist policy announcement, the number of state hospital admissions decreased by 22%, from 17,419 admissions in fiscal year 2007 to 13,570 admissions in fiscal year 2008 (Center for Mental Health Services, 2007; Center for Mental Health Services, 2008). At the same time, the length of state hospital waitlists increased. Waitlist data indicate that in 2008, an average of nearly 350 patients were placed on a waitlist each month. Waitlisted patients were referred to a state hospital by a community-based provider and met the state hospitals' admission criteria of posing a risk to themselves or others but were unable to receive immediate admission. The majority of waitlisted patients each month (mean of 68%) were male, substantiating state hospital administrator accounts that the male treatment units tended to operate at capacity more frequently and with longer wait times to admission as compared to female treatment units (meeting July 29, 2009). Overall, state hospitals reported a mean monthly wait time of 19 hours, although in the most extreme cases, patients waited for over a week for admission, with 55% of waitlisted patients not admitted to the state hospital at all. Among those not admitted to a state hospital, nearly half were either sent home from their location of referral (21%) or had dispositions that were unknown (27%).

Given the backlog of patients experiencing psychiatric crises within communities and the lack of prior research on the effects of these backlogs, the current study aimed to evaluate the extent to which state hospital waitlists had an external impact on use of general hospital EDs by people with SMI. Specifically, the study tested the hypotheses that the post-waitlist period would be associated with (1) an increased probability of having any behavioral health-related ED visits in a given month, (2) an increased number of behavioral health-related ED visits in a given month, and (3) longer ED visits for people with SMI. Increases in the frequency and length of stay of ED visits were expected as people who previously would have been admitted to state hospitals (even when overcrowded) were forced to wait in communities until psychiatric beds became available, potentially shifting the primary responsibility of crisis stabilization to EDs. The effects of the waitlists were expected to be most pronounced following waitlist *implementation* at each hospital. However, effects could have been anticipated based on date of waitlist policy *announcement*, as hospitals may have started

restricting admissions in response to the policy without officially placing patients on waitlists. In addition, the effects of the waitlists were expected to vary across individuals. Specifically, post-waitlist effects were expected to be larger for males (who, as previously mentioned, tend to be placed on waitlists more frequently). Post-waitlist effects were also expected to be larger for people with more severe diagnoses of schizophrenia and bipolar disorder (in contrast to people with major depression, who may be easier to place in alternative community-based settings).

METHODS

Data

North Carolina Medicaid data served as the main source of data in this study. These data were obtained from the University of North Carolina's Carolina Cost and Quality Initiative (CCQI), a computer-based data archive of de-identified Medicaid claims and other health service utilization data from the State Employees Health Plan. The data included information on all health care services reimbursed by Medicaid within the state for people with administrative diagnoses of schizophrenia, bipolar disorder, or major depression (http://www.shepscenter.unc.edu/data/ccqi-carolina-cost-and-quality-initiative/). Two separate data extractions occurred, resulting in an overall sample of Medicaid enrollees with at least one of the listed diagnoses between January 1, 2004 and December 31, 2007 and Medicaid enrollees with at least one of the listed diagnoses between January 1, 2008 and December 31, 2009.

State psychiatric hospital waitlist data were also used to determine the date of waitlist implementation for each hospital. The waitlist data were obtained from North Carolina's Division of State Operated Healthcare Facilities (DSOHF) and contain information on the monthly number of patients placed on a waitlist and number of days operating on a waitlist, as reported by each state hospital.

Four additional data sources were used in the study's main analyses to control for county-level availability of mental health resources and unemployment rates, which may have changed around the time of waitlist implementation and also affected ED utilization. First, annual data on the number of licensed psychiatrists in North Carolina counties were obtained from the state's Health Professions Data System (North Carolina Health Professions Data System, 2004-2010). Similarly,

the annual number of licensed adult psychiatric beds in private psychiatric hospitals and general hospital psychiatric units were obtained from North Carolina's State Medical Facilities Plans (North Carolina Division of Health Service Regulation, 2004-2010). All mental health resource control variables were adjusted for changes in population over the study period using population estimates from the U.S. Census Bureau (U.S. Census Bureau, 2010). Last, county-level monthly unemployment rates were obtained from the Bureau of Labor Statistics (Bureau of Labor Statistics, 2012). Previous research has linked increases in unemployment rates with several factors that may affect ED utilization, including decreased rates of insurance (Cawley et al., 2013; Cawley and Simon, 2005) and use of preventive care (Tefft and Kageleiry, 2013), as well as increased rates of potentially avoidable emergency admissions (O'Cathain et al., 2013) and psychiatric hospitalizations (Fortney et al., 2007; Kammerling and O'Connor, 1993).

Sensitivity analyses also used data on the number of state hospital beds in operation over time, to control for bed capacity reductions that occurred during the study period. These data were collected from several sources due to incomplete or inaccurate data from any single source. Specifically, the American Hospital Association's Guides to the Health Care Field provided information on the annual number of staffed beds at each of the state hospitals (AHA, 2003-2009). However, the AHA Guides relied on previous year's estimates when state hospitals did not report, resulting in measurement error (for example, closed hospitals in the state were reported to still have staffed capacity). As a secondary source, annual information on operating capacity was also collected from the Centers for Medicare and Medicaid Services' Hospital Cost Reports (CMS, 2004-2009). The Cost Reports provided the number of beds available for patient use in each hospital, as reported by the state's Medicare Administrative Contractors to the Healthcare Cost Report Information System. However, suspicious values were detected for certain hospitals. Data from the AHA Guides and Cost Reports were combined to create a single measure of state hospital capacity in each region, using the source that best matched author expectations of annual capacity in each hospital. Last, annual estimates of statewide operating capacity from North Carolina's DSOHF were also used in sensitivity analyses (White, 2012). These data were not available from DSOHF separately by state hospital. Since all measures of state hospital capacity were reported annually at

the end of each fiscal year, monthly capacity was estimated using linear interpolation to smooth capacity changes between consecutive years.

Sample

A number of selection criteria were applied to the original Medicaid data obtained from CCQI. In an effort to capture North Carolina's Medicaid population with SMI, the final sample included Medicaid enrollees with at least one inpatient visit or two outpatient visits indicating a diagnosis of SMI between January 1, 2004 and December 31, 2009. SMI was defined based on the presence of ICD-9-CM codes corresponding to schizophrenia or other nonorganic psychoses (295, 298, excluding 298.2), bipolar disorder (296, excluding 296.2-296.3), and major depression (296.2-296.3). Partial dual eligible enrollees (n=39,535), or people who receive Medicaid benefits to help offset Medicare costs but are not eligible for full Medicaid benefits, were excluded from analyses since episodes of care paid fully by Medicare were not visible in the Medicaid claims. People who were fully dual eligible were included in the sample since the portion of their episodes of care paid for by Medicaid was available in the claims. Regardless of dual eligibility status, people residing in a five-county region with a Medicaid behavioral health carve-out program (n=97,167 enrollees living in Cabarrus, Davidson, Rowan, Stanly, or Union counties) were excluded since primary behavioral health episodes of care were not included in the claims data.

Post-waitlist changes in the frequency of ED visits were analyzed at the person-month level (i.e., there are monthly observations for each person with SMI enrolled in Medicaid during each month, regardless of whether the person used any services). Monthly observations for people who were Medicaid eligible for less than 90% of the month were excluded from analyses. This exclusion criterion was applied in an effort to balance using all data available while minimizing the risk of missing ED visits that occurred during periods of lapsed Medicaid coverage. However, resulting ED visit rates may still be underestimated as a result of this exclusion criterion, particularly if general hospitals frequently enroll uninsured people in Medicaid during ED visits.

The sample's age range was selected to focus on people most affected by the state hospital waitlist policy. State hospital waitlist data and conversations with state hospital administrators indicate that the adult treatment units (serving patients aged 18 to 64 years), as opposed to the

geriatric and child/adolescent treatment units, are the units that operate on a waitlist most often. For example, based on state hospital waitlist data from 2008, an average of nearly 90% of patients who were admitted to a state hospital from the waitlist were admitted to adult acute treatment units. In contrast, an average of only 1% of waitlisted admissions were to a geriatric treatment unit and 1% of waitlisted admissions were to a child and adolescent treatment unit. Using a difference-in-difference approach, the study's treatment group included person-month observations for adults aged 18 to 64 years at the beginning of each month. The control group included person-month observations for people aged 65 to 74 years who were not in a skilled nursing facility; sensitivity analyses used an alternative control group of person-month observations for people aged 13 to 17 years. Since the treatment and control groups were defined based on age at the beginning of each month, enrollees from the treatment group were able to age into the control group over the course of the study period.

The final sample included 160,143 non-elderly adult Medicaid enrollees with SMI, providing 7,172,660 person-month observations (or an average of 44.8 monthly observations per person over the 72-month study period). The control group sample of elderly adults was much smaller, with 7,949 enrollees providing 287,187 person-month observations.

Post-waitlist changes in ED visit length of stay were examined at the visit-level. The visit-level file included all ED visits already captured in the person-month-file, but provided additional detail on the length of stay of individual ED visits. The final visit-level sample included 1,406,090 ED visits (1,372,348 visits from non-elderly adult enrollees and 33,742 visits from elderly enrollees in the study's control group).

Measures

The three main dependent variables in this study measured the frequency and length of stay of ED visits. ED visits were identified in the Medicaid claims using category of service code (50), procedure codes (99281-99285), and revenue codes (RC450-RC452, RC456, RC459) corresponding to ED visits, regardless of whether the ED visits resulted in admission to an inpatient unit. Measures of the frequency of ED visits included a binary variable indicating whether there were any ED visits during the month and a count of the number of ED visits during the month. ED length of stay in days was calculated by subtracting the date of ED admission from the date of ED discharge (e.g., a person

who was admitted to and discharged from the ED on the same date would have a zero-day length of stay).

In main analyses, two different ED visit specifications were used to measure ED utilization. In the first specification, all ED visits were included, regardless of reason for visit (i.e., medical, injury, or behavioral health). The second specification focused on identifying ED visits that were behavioral health-related. This definition included all ED visits with a mental health or substance abuse diagnosis code listed anywhere in the ED visit record. This specification may underestimate ED visits by people with SMI if behavioral health diagnoses are not consistently reported by providers. ED visits would be overestimated if providers report behavioral health diagnoses even if visits are unrelated to behavioral health conditions. Two additional methods for identifying behavioral health-related ED visits were used in sensitivity analyses. The first method included all ED visits with a mental health or substance abuse diagnosis code listed first in the ED visit record. The second method included all ED visits with a mental health or substance abuse screening, medication management, or medication injection procedure code occurring on the same date as an ED visit, regardless of diagnoses. The ICD-9-CM codes and procedure codes used in these behavioral health-related ED visit definitions are provided in Table 3.1.

Key independent variables included a binary variable indicating whether the observation was post-waitlist and a linear time trend interacted with the post-waitlist indicator. Here, the post-waitlist period was defined in two ways, based on date of policy *implementation* and date of policy *announcement*. For policy implementation, the post-waitlist period began on the first day of the first month when each state hospital operated on a waitlist for at least five days. For policy announcement, the post-waitlist period began in March 2007 (with observations from February 2007 excluded from analyses since the policy was announced mid-month). Using a difference-in-difference approach, both post-waitlist variables were interacted with a binary indicator for treatment group (equal to one for people aged 18-64 years and zero for the control group of people aged 65-74 years who were not in an SNF).

Analyses also controlled for linear time trends, seasonality, county-level availability of mental health services, county unemployment rates, and person-level characteristics. These person-level

characteristics included age at the beginning of each month, sex, race (white, black, other minority, or unknown), ethnicity (non-Hispanic, Hispanic, or unknown), and dual eligible insurance status (fully dual eligible for Medicare and Medicaid vs. not dual eligible). Three dummy variables controlled for SMI diagnoses (ever diagnosed with schizophrenia or other nonorganic psychoses, ever diagnosed with bipolar disorder, and ever diagnosed with major depression). In addition, the number of medical, mental health, and substance abuse comorbidity diagnoses ever present were identified using the ICD-9-CM codes listed in Table 3.2. Here, the medical comorbidities were classified using the Enhanced Elixhauser algorithm (Quan et al., 2005). The mental health and substance abuse comorbidities drew on the Enhanced Elixhauser algorithm and further included additional ICD-9-CM codes clustered into clinically meaningful groups.

Main Analysis

Pre- and post-waitlist differences in the proportion of person-month observations with at least one ED visit, the mean number of ED visits in the month (regardless of whether observations had any visits during the month), and the mean ED length of stay were examined using descriptive and time-trend analyses. In addition, a difference-in-difference approach was used to estimate 12 regression models (corresponding to the study's three dependent variables, with two ED visit specifications each, defining the post-waitlist period based on date of waitlist policy implementation and announcement). In each of these models, the difference in pre- and post-waitlist ED utilization outcomes for the group of Medicaid enrollees aged 18-64 years (treatment group) were compared to the difference in pre- and post-waitlist ED utilization outcomes for the group of Medicaid enrollees aged 65-74 years who were not in an SNF (control group).

As previously mentioned, the difference-in-difference approach using control groups was feasible because state hospital waitlist data indicated that certain groups of people may have been less affected by the waitlists than other groups. That is, if hospitals are not at capacity for certain units such as geriatrics, then the waitlist will not affect patterns of care (nonbinding constraint). The final control group of people aged 65-74 years who were not in an SNF was selected based on preliminary analyses that indicated similar trends for ED utilization outcome variables as compared to the treatment group in the pre-waitlist period (Figures 3.1 and 3.2). ED length of stay was the only

variable where the pre-waitlist trends in the control group did not match the treatment group (Figure 3.3).

Binary outcome variables (any ED visits in month) were modeled using linear probability models for ease of interpreting results. One of the main limitations of these models is that they can produce out-of-range predictions (probabilities less than zero or greater than one). However, most of the study's main models predicted less than 5% out-of-range probabilities, with all main models predicting less than 13% out-of-range probabilities.

Count outcome variables (number of ED visits in month and ED visit length of stay in days) were modeled using hurdle models to account for zero-inflation in the outcomes. A total of 86.8% of person-month observations had zero ED visits and 96.7% of ED visits had a length of stay of zero (i.e., patients were admitted and discharged on the same date). The first part of the hurdle models used logit models to estimate whether the count outcome was greater than zero; the second part used ordinary least squares models to estimate the count for observations with non-zero outcomes only. For example, the hurdle model of ED length of stay included all ED visits and modeled the probability of having a length of stay greater than zero days (part one of the model) before modeling the length of stay only for ED visits with a length of stay greater than zero days (part two of the model).

Sensitivity Analyses

Seven sensitivity analyses were conducted to examine whether regression results were robust to other model specifications. The first two sensitivity analyses used the alternative definitions for "behavioral health-related" ED visits. The third and fourth sensitivity analyses included measures of state psychiatric hospital bed capacity per 100,000 population (statewide and by state hospital region). These variables were not included in the main analysis because estimates from North Carolina's DSOHF were only available at the state-level and region-level estimates from other data sources were questionable, as already discussed. The fifth sensitivity analysis excluded people with major depression from the final sample of Medicaid enrollees with SMI (i.e., limiting the sample to people ever diagnosed with schizophrenia, other nonorganic psychoses, or bipolar disorder).

The sixth sensitivity analysis used people aged 13-17 years as a control group instead of people aged 65-74 years. Similar to the older control group, the control group of adolescents also had similar pre-waitlist trends on ED utilization outcomes as compared to the treatment group. However, adolescents were only included as a control group in sensitivity analyses because reports indicated that state-run inpatient services for children may have been equally as strained as those services for non-elderly adults, despite what the state hospital waitlist data reported (Disability Rights North Carolina, 2011; Duda and Rash, 2011). Duda and Rash (2011) reported that at any given time an average of 30 to 60 children are waiting for placement in one of the state's facilities that provides inpatient care for children. The discrepancies between these reports and state hospital waitlist data may be due to the fact that limited inpatient care for children and adolescents is provided in state hospitals, with additional care provided in state-run and private psychiatric residential treatment facilities (PRTFs). PRTFs may also be operating on waitlists that are not reported to DSOHF for monitoring.

The last sensitivity analysis used a pre-post comparison of ED utilization measures for people aged 18-64 years with SMI, excluding any control group. This analysis was conducted in case the control groups of geriatric and adolescent enrollees were considered inappropriate for any reason

For all models, clustered standard errors were included to account for multiple observations for each enrollee. Models were run overall as well as separately by patient sex and SMI diagnoses to determine if waitlist effects varied across these dimensions. Although individual-level fixed effects were considered, they were ultimately not included in analyses since similar results were attained from pooled models. Reported results include average marginal effects with standard errors estimated using 100 bootstrap replications, as well as predicted probabilities and counts with 95% confidence intervals. Average marginal effects are reported after "differencing out" the effects of the waitlist on the control group, as well as separately for the treatment and control groups. All analyses were conducted using Stata version 12.1 (College Station, Texas). Alpha levels of 0.05, 0.01, and 0.001 are reported, although results should be interpreted taking into account the study's large sample size. The Institutional Review Board at the University of North Carolina at Chapel Hill approved the study.

RESULTS

Table 3.3 contains descriptive statistics for the population of Medicaid enrollees with SMI, by person-month observations and by enrollees. The average age of non-elderly adult enrollees was 40.1 years, with the majority of person-month observations for enrollees who were female, white, non-Hispanic, and not dual eligible for Medicare. Major depression was the most common SMI diagnosis (67.4% of observations ever diagnosed), followed by bipolar disorder (53.6%), and schizophrenia or other nonorganic psychoses (38.2%). Characteristics of the study's elderly control group are also provided in Table 3.3.

Between 2004 and 2009, Medicaid enrollees with SMI visited the ED over 1.4 million times, with a mean length of stay of 0.2 days. Of these ED visits, 37.1% (n=522,178) had a mental health or substance abuse diagnosis listed *anywhere* in the ED visit record, 18.5% (n=260,131) had a mental health or substance abuse diagnosis listed *first* in the ED visit record, and 9.6% (n=135,419) had a mental health or substance abuse *procedure code* listed on the same date as an ED visit.

At the person-month level, 13.2% of all observations had an ED visit in a given month, with a mean of 0.2 ED visits. Fewer person-month observations had behavioral health-related ED visits in each month, with 5.6% having a behavioral health-related ED visit in the month based on all diagnoses, 2.8% based on first-listed diagnoses, and 1.6% based on procedure codes. As shown in Table 3.4, ED utilization differed between the treatment and control groups, although there were limited differences in outcomes pre- and post-waitlist. For example, in the treatment group, the percent of observations with any ED visits increased from 13.2% pre-waitlist to 13.6% post-waitlist implementation, a relative increase of only 2.9% ($p<0.001$). In contrast, the percent of observations with any behavioral health-related ED visits increased from 5.2% pre-waitlist to 6.2% post-waitlist implementation, a relative increase of 18.6% ($p<0.001$, using the least restrictive definition for behavioral health-related ED visits). Somewhat smaller results were found when the post-waitlist period was defined based on date of policy announcement, with a relative increase of 1.1% in all ED visits and 13.0% in behavioral health-related ED visits (13.3% pre- vs. 13.4% post-waitlist announcement and 5.3% pre- vs. 6.0% post-waitlist announcement, respectively, with both $p<0.001$). The time series plots in Figure 3.1 provide additional information on these measures over time. In

these plots, the relatively stable trend for all ED visits can be compared to the gradually increasing trend for behavioral health-related ED visits.

The mean number of ED visits did not change post-waitlist by any clinically meaningful amount (post-waitlist mean number of visits were within 0.01 of pre-waitlist mean number of visits). This was true both overall and for behavioral health-related ED visits (Figure 3.2), regardless of whether the post-waitlist period was defined based on date of implementation or policy announcement. Finally, mean ED length of stay decreased slightly post-waitlist. For the treatment group, the mean length of stay for behavioral health-related ED visits decreased post-waitlist from 0.3 days to 0.2 days ($p<0.001$) based on the definition of behavioral health-related ED visits that uses all diagnoses. A closer look at mean ED length of stay over time (Figure 3.3) indicates that these results may be driven by longer stays early in the study period. Mean length of stay then decreased in the pre-waitlist time period, before increasing after waitlist implementation. These trends are more pronounced in the control group, which has longer mean ED visits in general (potentially a limitation of the Medicaid data, which may be incorrectly assigning part of geriatric patients' inpatient hospital stays to the ED visit).

Results from regression models are partially consistent with the study's main hypotheses that the waitlist policy was associated with increases in the frequency and length of stay of ED visits (Table 3.5). Average marginal effects from the linear probability models indicate that waitlist implementation was associated with a 0.91% increase in the probability of having any ED visits in a given month ($p<0.001$). The average marginal effect was slightly smaller (0.56%, $p<0.05$) when the post-waitlist period was defined based on date of policy announcement. Increases in the probability of any ED visits in a given month were also consistent across most sensitivity analyses, although it should be noted that effects were larger when people diagnosed only with major depression were excluded from the final sample (1.13% increase, $p<0.001$). Results were sensitive to the control group selected; in the sensitivity analysis that used adolescents as a control group, the average marginal effect of the waitlist policy was not statistically significant. In the sensitivity analysis that excluded a control group, waitlists were also not associated with an increase in the probability of having any ED visits in a given month.

Linear probability models examining any behavioral health-related ED use by Medicaid enrollees with SMI also generally found small average marginal effects of the waitlist policy. The two exceptions were when the post-waitlist period was defined based on date of policy announcement and when "behavioral health-related" ED visits were defined based on procedure codes rather than diagnoses; in both of these analyses waitlists had no effect on behavioral health-related use. However, when the post-waitlist period was defined based on date of policy implementation, waitlists were associated with a 0.91% increase in the probability of having any behavioral health-related ED visits in a given month ($p<0.001$). The magnitude of effects across all other sensitivity analyses ranged from 0.19% when control groups were not used to 1.09% when Medicaid enrollees diagnosed only with major depression were excluded from the final sample (both at $p<0.001$).

Average marginal effects of the waitlist policy on number of ED visits in a given month were not clinically meaningful. For example, waitlist implementation was associated with an increase of 0.02 ED visits overall and an increase of 0.01 behavioral health-related ED visits in a given month (both at $p<0.001$). Across all models, the effects of waitlists on the number of ED visits were smaller than 0.03 in absolute value.

Average marginal effects were somewhat larger, although still relatively small, for ED visit length of stay. Waitlist policy implementation and announcement were associated with 0.12 day and 0.19 day increases in overall ED length of stay, respectively (both at $p<0.001$). These effects were generally consistent across sensitivity analyses, with the exception of the last two sensitivity analyses. The magnitude *and* direction of effects changed when adolescents were used as a control group and when no control groups were included in analyses (both with -0.03 day effects at $p<0.001$). The magnitude of effects was generally larger for behavioral health-related ED visits. Waitlist policy implementation and announcement were associated with 0.27 day and 0.39 day increases in behavioral health-related ED length of stay, respectively (both at $p<0.001$). Again, these results were sensitive to the control group selected, with results from sensitivity analyses using adolescents as a control group or no control group indicating negative effects of waitlist implementation on behavioral health-related ED length of stay (both with -0.07 day effects at $p<0.001$).

Given the sensitivity of results to the control group used in analyses, average marginal effects for all outcomes are also provided separately for the treatment and control groups in Table 3.6. From these results it is apparent that ED length of stay decreased post-waitlist in both the treatment and control groups, but that the reduction was greater in the geriatric control groups, leading to a net positive effect when the geriatric control group's effects were differenced out of the treatment group's effects. Table 3.7 provides predicted values of all outcomes pre- and post-waitlist by treatment and control groups to further assist with interpretation of results. Predicted values for most outcomes either remained unchanged or decreased post-waitlist, although larger reductions occurred for the control group as compared to the treatment group. The two exceptions were the predicted percent of people with any behavioral health-related ED visits and the predicted number of behavioral health-related ED visits in a given month, which both increased slightly post-waitlist for non-geriatric adults. Effects of the waitlists were similarly small in models run separately by sex and SMI diagnoses (not shown).

DISCUSSION

Results from the current study were partially consistent with hypotheses that waitlists resulted in increases in the frequency and length of stay of ED visits by people with SMI. Effects across all ED utilization outcomes were relatively small. For example, waitlist implementation was associated with a 0.9% increase in the probability of Medicaid enrollees with SMI having any ED visits in a given month (overall or behavioral health-related, $p<0.001$). Although this effect is small in absolute value, it should be noted that the predicted percent of non-geriatric adults with any ED visits in a given month pre-waitlist was only 13.3% for all ED visits and 5.4% for all behavioral health-related ED visits in the pre-waitlist period. Since ED visits are a relatively rare event, it is possible that even a small post-waitlist increase in ED use by Medicaid enrollees with SMI is being felt within EDs. Effects of the waitlists on the number of ED visits in a given month by Medicaid enrollees with SMI were statistically significant increases, but were not clinically meaningful.

Results related to ED visit length of stay indicate that waitlist implementation was associated with a 0.12 day increase in length of stay for all ED visits, with an even greater 0.27 day increase in length of stay for behavioral health-related ED visits. In hours, these effects translate to longer ED

visit stays by approximately 2.9 hours and 6.5 hours, respectively. However, these results were sensitive to the control group chosen and should be interpreted accordingly. For results reported separately by treatment and control groups, the average marginal effects of the waitlists on ED length of stay were negative and predicted length of stay post-waitlist decreased in both groups. In other words, ED length of stay decreased for both groups post-waitlist, but these reductions were smaller for the treatment group. These findings could reflect active efforts by EDs to respond to the waitlists and stabilize or admit patients in psychiatric crisis in a timely manner.

Several additional factors could also help to explain the study's findings of relatively small waitlist effects. First, it is possible that the network of community-based providers who are able to manage psychiatric crises was strengthened around the same time as the waitlist policy, helping to distribute crisis stabilization responsibilities across service providers. The current study was able to control for increases in inpatient psychiatric capacity in private psychiatric hospitals and general hospital psychiatric units. However, longitudinal data on the capacity of mobile crisis services, psychiatric crisis facilities, and intensive outpatient services were not available.

In addition, the analyses were limited to North Carolina Medicaid enrollees with SMI between 2004 and 2009. The Medicaid data allowed for the independent identification of people with SMI (as opposed to relying solely on ED visit data). However, it is unclear whether results extend to people with other mental health and substance abuse diagnoses, or to people with SMI who are uninsured or privately insured. A recent analysis of North Carolina ED visits across all payers found that the annual number of ED visits increased by 5.1% between 2008 and 2010, but that this increase was larger (17.7%) for ED visits with a mental health disorder diagnostic code (Hakenewerth et al., 2013). Uninsured people may have been affected by the waitlists to a greater extent than the Medicaid population, particularly since North Carolina's state psychiatric hospitals provide a disproportionate share of inpatient care to people who are uninsured. State hospital utilization data indicate that nearly 49% of all state hospital visits by adult-aged patients between July 2006 and December 2011 did not have insurance information recorded for the visit, indicating that the patients were either self-pay or uninsured.

Similarly, recent reports suggest that the state hospital waitlists have continued to grow since 2009 (North Carolina Division of State Operated Healthcare Facilities 2012). The current study provides an evaluation of waitlists in the first three years following policy announcement, although it is possible that the effects of the waitlists on EDs are being felt more in recent years. Additional research should examine whether effects on EDs and other mental health service providers have increased in recent years with the growing waitlists.

The Medicaid data also provided limited information on reasons for ED visits and patient length of stay in the EDs. ICD-9-CM diagnosis codes as well as mental health and substance abuse procedure codes were used to classify ED visits as behavioral health-related using multiple definitions in sensitivity analyses. Some misclassification of ED visits as behavioral health-related likely occurred, however, there is no reason to believe that this misclassification occurred at different rates pre- and post-waitlist. Similarly, length of stay in the ED was measured in days based on date of admission and date of discharge and could not be measured on an hourly basis. Additional research should examine changes in ED length of stay using a data source that measures ED length of stay in finer detail.

Last, as previously mentioned, the waitlist policy was promulgated statewide at the same time. Although implementation varied by hospital, the state did not take specific measures to implement the policy in a way that would support its rigorous evaluation (for example, by implementing the waitlists in only one part of the state and randomizing state hospitals to intervention and control groups). The current study uses a control group of patients presumably less affected by the waitlists. However, it is possible that geriatric inpatient services were also operating on waitlists more than the state hospital waitlist data indicated.

CONCLUSIONS

Results from the current study suggest that the external effects of state psychiatric hospital waitlists on the use of general hospital EDs by Medicaid enrollees with SMI were limited. These findings may provide preliminary evidence that North Carolina's mental health system is managing to cope with people in psychiatric crisis in the post-waitlist era without overburdening EDs. However, further research is needed to determine whether these effects are any greater for uninsured

populations, which have been a large proportion of state hospital users. The challenge in addressing these effects is that there is no publicly-available, centralized administrative database such as Medicaid claims whereby the subsequent experiences of uninsured people can be tracked and assessed.

Table 3.1: ICD-9-CM codes and procedure codes used to define behavioral health-related ED visits

Behavioral health-related ED visit definition	ICD-9-CM or procedure codes	Description
Presence of any mental health or substance abuse diagnoses listed anywhere (or listed first) in ED visit record	ICD-9-CM codes 290-294	Organic psychotic conditions, including dementias, drug- or alcohol-induced mental disorders, and transient or persistent mental disorders due to conditions classified elsewhere
	ICD-9-CM codes 295-299	Other psychoses, including schizophrenic disorders, episodic mood disorders, delusional disorders, other nonorganic psychoses, and pervasive developmental disorders
	ICD-9-CM codes 300-316	Neurotic disorders, personality disorders, and other non-psychotic mental disorders
	ICD-9-CM codes 648.4, V62.8, V66.3, V67.3, V70.1-V70.2, V71.0, V79.0, V79.1, V79.8-V79.9, E95	Other mental health and substance abuse disorders
Presence of mental health or substance abuse screening, medication management, or medication injection procedure code occurring on the same date as an ED visit	Procedure codes 80100-80102, 82055, 90801-90802, 96101-96103, 96150, G0396-G0397, H0001-H0003, H0031, H0048-H0049	Psychological testing and drug/alcohol screening
	Procedure codes 90862, H0020, H0033-H0034, H2010, M0064	Psychiatric medication management
	Procedure codes J1630-J1631, J2680, J2794, S0163	Psychiatric medication injections, including injection of haloperidol, haloperidol decanoate, fluphenazine decanoate, and risperidone

Table 3.2: ICD-9-CM codes used to classify medical, mental health, and substance abuse comorbidities

Description	ICD-9-CM codes
Medical comorbidities (Quan et al., 2005)[a]	
1. Congestive heart failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.4-425.9, 428.x
2. Cardiac arrhythmias	426.0, 426.13, 426.7, 426.9, 426.10, 426.12, 427.0-427.4, 427.6-427.9, 785.0, 996.01, 996.04, V45.0, V53.3
3. Valvular disease	093.2, 394.x-397.x, 424.x, 746.3-746.6, V42.2, V43.3
4. Pulmonary circulation disorders	415.0, 415.1, 416.x, 417.0,417.8, 417.9
5. Peripheral vascular disorders	093.0, 437.3, 440.x, 441.x, 443.1- 443.9, 447.1, 557.1, 557.9, V43.4
6. Hypertension, uncomplicated	401.x
7. Hypertension, complicated	402.x-405.x
8. Paralysis	334.1, 342.x, 343.x, 344.0-344.6, 344.9
9. Other neurological disorders	331.9, 332.0, 332.1, 333.4, 333.5, 333.92, 334.x-335.x, 336.2, 340.x, 341.x, 345.x, 348.1, 348.3, 780.3, 784.3
10. Chronic pulmonary disease	416.8, 416.9, 490.x -505.x, 506.4, 508.1, 508.8
11. Diabetes, uncomplicated	250.0-250.3
12. Diabetes, complicated	250.4-250.9
13. Hypothyroidism	240.9, 243.x, 244.x, 246.1, 246.8
14. Renal failure	403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 585.x, 586.x, 588.0, V42.0, V45.1, V56.x
15. Liver disease	070.22, 070.23, 070.32, 070.33, 070.44, 070.54, 070.6, 070.9, 456.0-456.2, 570.x, 571.x, 572.2-572.8, 573.3, 573.4, 573.8, 573.9, V42.7
16. Peptic ulcer disease, excluding bleeding	531.7, 531.9, 532.7, 532.9, 533.7, 533.9, 534.7, 534.9
17. AIDS/HIV	042.x-044.x
18. Lymphoma	200.x-202.x, 203.0,238.6
19.Metastatic cancer	196.x-199.x
20.Solid tumor without metastasis	140.x-172.x, 174.x-195.x
21. Rheumatoid arthritis/ collagen vascular diseases	446.x, 701.0, 710.0-710.4, 710.8, 710.9, 711.2, 714.x, 719.3, 720.x, 725.x, 728.5, 728.89, 729.30

(Continued)

Table 3.2: *(Continued)*

Description	ICD-9-CM codes
22. Coagulopathy	286.x, 287.1, 287.3-287.5
23. Obesity	278.0
24. Weight loss	260.x-263.x, 783.2, 799.4
25. Fluid and electrolyte disorders	253.6, 276.x
26. Blood loss anemia	280.0
27. Deficiency anemia	280.1-280.9, 281.x
Mental health comorbidities (non-SMI)	
1. Other psychoses	290.x, 293.x-294.x, 297.x, 298.2, 299.x
2. Mild depression	300.4, 311.x
3. Other episodic mood disorders	296.9
4. Stress and adjustment disorders	308.x-309.x
5. Personality disorders	301.x
6. Conduct disorders	312.x
7. Emotional disturbance disorders	313.x
8. Neurotic disorders	300.0-300.3, 300.5-300.9
9. Other mental health disorders	302.x, 306.x-307.x, 310.x, 314.x-316.x, 648.4, V62.8, V66.3, V67.3, V70.1-V70.2, V71.0, V79.0, V79.8-V79.9, E95
Substance abuse comorbidities	
1. Alcohol-related disorders	291.x, 303.x, 305.0, V79.1
2. Drug-related disorders	292.x, 304.x, 305.1-305.9, 648.3

Notes:
[a] The medical comorbidities follow the Enhanced Elixhauser coding algorithm, but exclude the algorithm's last four comorbidities related to alcohol abuse, drug abuse, psychoses, and depression. These comorbidities are captured in the substance abuse and mental health comorbidity measures, which are grouped into clinically meaningful groups.

Table 3.3: Characteristics of Medicaid enrollees with SMI (2004-2009), by person-month observations and by Medicaid enrollees

Variable	Person-month observations		Medicaid enrollees	
	Treatment group of adults aged 18-64 (n=7,172,660)	Control group of adults aged 65-74 (n=287,187)	Treatment group of adults aged 18-64 (n=160,143)	Control group of adults aged 65-74 (n=7,949)
Categorical variables, n (%)[a]				
Sex				
Male	2,201,750 (30.7)	81,367 (28.3)	51,077 (31.9)	2,263 (28.5)
Female	4,970,910 (69.3)	205,820 (71.7)	109,066 (68.1)	5,686 (71.5)
Race				
White	4,117,456 (57.4)	163,644 (57.0)	96,148 (60.0)	4,658 (58.6)
Black	2,692,588 (37.5)	98,697 (34.4)	55,888 (34.9)	2,619 (33.0)
Other	160,714 (2.2)	5,563 (1.9)	3,428 (2.1)	154 (1.9)
Unknown	201,902 (2.8)	19,283 (6.7)	4,679 (2.9)	518 (6.5)
Ethnicity				
Hispanic	97,190 (1.4)	3,824 (1.3)	2,779 (1.7)	119 (1.5)
Non-Hispanic	6,024,107 (84.0)	203,577 (70.9)	136,349 (85.1)	5,659 (71.2)
Unknown	1,051,363 (14.7)	79,786 (27.8)	21,015 (13.1)	2,171 (27.3)
Insurance status[b]				
Medicaid only	5,018,396 (70.0)	32,864 (11.4)	110,174 (68.8)	751 (9.5)
Fully dual eligible for Medicaid / Medicare	2,154,264 (30.0)	254,323 (88.6)	49,969 (31.2)	7,198 (90.6)
SMI diagnosis (ever)				
Schizophrenia or other nonorganic psychoses	2,738,151 (38.2)	159,380 (55.5)	52,515 (32.8)	4,147 (52.2)
Bipolar disorder	3,841,276 (53.6)	91,013 (31.7)	84,591 (52.8)	2,502 (31.5)
Major depression	4,834,568 (67.4)	160,864 (56.0)	104,369 (65.2)	4,299 (54.1)
Continuous variables, mean (standard deviation)				
Age[c]	40.1 (12.6)	69.3 (2.9)	35.2 (13.8)	65.4 (4.4)
Number of comorbid conditions (ever)				
Medical comorbidities	4.0 (3.5)	6.0 (3.6)	3.3 (3.3)	5.0 (3.8)
Mental health comorbidities (non-SMI)	2.4 (1.5)	1.8 (1.4)	2.1 (1.6)	1.4 (1.3)
Substance abuse comorbidities	0.8 (0.7)	0.4 (0.6)	0.7 (0.7)	0.3 (0.6)

Notes:

[a] All categorical variables are mutually exclusive (sum to 100% within columns, by subgroups), with the exception of SMI diagnosis.

[b] Insurance status is based on whether person was dual eligible during month for statistics by person-month observations and whether person was ever dual eligible for statistics by Medicaid enrollees.

[c] Age is provided as mean age at beginning of month for statistics by person-month observations and mean age on January 1, 2004 for statistics by Medicaid enrollees.

Table 3.4: Emergency department (ED) utilization pre- and post-waitlist for treatment and control groups

Type of ED visit	Percent of person-month observations with any ED visits during month (unadjusted)			Mean number (std. deviation) of ED visits in person-month observation (unadjusted)			Mean length (std. deviation) of ED visits, in days		
	Pre-waitlist	Post-waitlist	Difference (p-value)[a]	Pre-waitlist	Post-waitlist	Difference (p-value)[a]	Pre-waitlist	Post-waitlist	Difference (p-value)[a]
Defining post-waitlist period based on date of policy implementation									
Treatment group of adults aged 18-64									
Any ED visits	13.18	13.56	0.38 (p<0.001)	0.19 (0.6)	0.20 (0.6)	0.01 (p<0.001)	0.16 (2.8)	0.14 (2.6)	-0.02 (p<0.001)
Behavioral health-related ED visits (any diagnoses)	5.21	6.18	0.97 (p<0.001)	0.07 (0.3)	0.08 (0.3)	0.01 (p<0.001)	0.29 (3.2)	0.21 (2.5)	-0.08 (p<0.001)
Behavioral health-related ED visits (first diagnosis)	2.69	3.10	0.40 (p<0.001)	0.03 (0.2)	0.04 (0.2)	0.01 (p<0.001)	0.39 (3.2)	0.30 (3.1)	-0.09 (p<0.001)
Behavioral health-related ED visits (procedure codes)	1.53	1.81	0.28 (p<0.001)	0.02 (0.1)	0.02 (0.2)	0.00 (p<0.001)	0.07 (0.9)	0.05 (1.0)	-0.02 (p=0.004)
Control group of adults aged 65-74									
Any ED visits	8.30	8.48	0.18 (p=0.09)	0.12 (0.4)	0.12 (0.4)	0.00 (p=0.4)	0.58 (2.4)	0.51 (2.3)	-0.06 (p=0.02)
Behavioral health-related ED visits(any diagnoses)	3.07	3.61	0.55 (p<0.001)	0.04 (0.2)	0.04 (0.3)	0.01 (p<0.001)	1.18 (3.5)	0.88 (2.9)	-0.30 (p<0.001)
Behavioral health-related ED visits (first diagnosis)	1.68	1.93	0.24 (p<0.001)	0.02 (0.2)	0.02 (0.2)	0.00 (p<0.001)	1.39 (4.2)	1.09 (3.6)	-0.30 (p=0.002)
Behavioral health-related ED visits (procedure codes)	0.42	0.60	0.18 (p<0.001)	0.00 (0.1)	0.01 (0.1)	0.00 (p<0.001)	0.21 (1.6)	0.14 (1.3)	-0.07 (p=0.3)
Defining post-waitlist period based on date of policy announcement									
Treatment group of adults aged 18-64									
Any ED visits	13.30	13.44	0.14 (p<0.001)	0.19 (0.6)	0.19 (0.6)	0.00 (p<0.001)	0.16 (2.7)	0.14 (2.7)	-0.03 (p<0.001)
Behavioral health-related ED visits (any diagnoses)	5.30	5.99	0.69 (p<0.001)	0.07 (0.3)	0.08 (0.3)	0.01 (p<0.001)	0.30 (2.9)	0.21 (2.8)	-0.09 (p<0.001)
Behavioral health-related ED visits (first diagnosis)	2.71	3.04	0.33 (p<0.001)	0.03 (0.2)	0.04 (0.2)	0.00 (p<0.001)	0.41 (2.8)	0.30 (3.4)	-0.11 (p<0.001)
Behavioral health-related ED visits (procedure codes)	1.52	1.79	0.27 (p<0.001)	0.02 (0.1)	0.02 (0.2)	0.00 (p<0.001)	0.07 (1.0)	0.05 (1.0)	-0.02 (p<0.001)

(Continued)

Table 3.4: *(Continued)*

Type of ED visit	Percent of person-month observations with any ED visits during month (unadjusted)			Mean number (std. deviation) of ED visits in person-month observation (unadjusted)			Mean length (std. deviation) of ED visits, in days		
	Pre-waitlist	Post-waitlist	Difference (p-value)[a]	Pre-waitlist	Post-waitlist	Difference (p-value)[a]	Pre-waitlist	Post-waitlist	Difference (p-value)[a]
Control group of adults aged 65-74									
Any ED visits	8.33	8.47	0.14 (p=0.17)	0.12 (0.5)	0.12 (0.4)	0.00 (p=0.97)	0.62 (2.5)	0.49 (2.3)	-0.13 (p<0.001)
Behavioral health-related ED visits (any diagnoses)	3.10	3.53	0.42 (p<0.001)	0.04 (0.2)	0.04 (0.2)	0.01 (p<0.001)	1.27 (3.6)	0.85 (2.9)	-0.42 (p<0.001)
Behavioral health-related ED visits (first diagnosis)	1.68	1.90	0.22 (p<0.001)	0.02 (0.2)	0.02 (0.2)	0.00 (p<0.001)	1.51 (4.2)	1.05 (3.6)	-0.46 (p<0.001)
Behavioral health-related ED visits (procedure codes)	0.40	0.59	0.19 (p<0.001)	0.00 (0.1)	0.01 (0.1)	0.00 (p<0.001)	0.24 (1.7)	0.14 (1.3)	-0.11 (p=0.2)

Notes:

[a] P-values were determined based on t-tests with unequal variances.

Table 3.5: Average marginal effects of the waitlist policy on ED utilization by Medicaid enrollees with SMI

Analysis scenario	Post-waitlist average marginal effect (standard error)[a]					
	All ED visits			Behavioral health-related ED visits[b]		
	Any visit in month, %[c] (n=7,459,847)	Number of ED visits in month[d] (n=7,459,847)	Length of ED visit, days[d] (n=1,406,090)	Any visit in month, %[c] (n=7,459,847)	Number of ED visits in month[d] (n=7,459,847)	Length of ED visit, days[d] (n=522,178)
Main Analysis: Defining post-waitlist period based on date of policy implementation	0.911*** (0.00)	0.019*** (0.00)	0.122*** (0.02)	0.908*** (0.00)	0.009*** (0.00)	0.273*** (0.06)
Main Analysis: Defining post-waitlist period based on date of policy announcement[e]	0.562* (0.00)	0.015*** (0.00)	0.185*** (0.03)	0.192 (0.00)	0.000 (0.00)	0.391*** (0.07)
Sensitivity Analysis 1: Defining "behavioral health-related" ED visits based on first-listed diagnoses[f]	--	--	--	0.414*** (0.00)	0.003** (0.00)	0.252* (0.11)
Sensitivity Analysis 2: Defining "behavioral health-related" ED visits based on procedure codes[g]	--	--	--	0.002 (0.00)	0.000 (0.00)	0.009 (0.04)
Sensitivity Analysis 3: Including statewide psychiatric beds in state hospitals per 100,000 population as control variable	0.915*** (0.00)	0.021*** (0.00)	0.087*** (0.02)	0.913*** (0.00)	0.011*** (0.00)	0.194** (0.06)
Sensitivity Analysis 4: Including regional psychiatric beds in state hospitals per 100,000 population as control variable	0.917*** (0.00)	0.018*** (0.00)	0.122** (0.02)	0.918*** (0.00)	0.008*** (0.00)	0.274*** (0.06)
Sensitivity Analysis 5: Excluding people with major depression from sample of Medicaid enrollees with SMI[h]	1.128*** (0.00)	0.023*** (0.00)	0.141*** (0.03)	1.093*** (0.00)	0.010*** (0.00)	0.296*** (0.07)
Sensitivity Analysis 6: Using adolescents aged 13-17 years as control group[i]	0.184 (0.00)	0.000 (0.00)	-0.034*** (0.01)	0.348*** (0.00)	0.001 (0.00)	-0.072*** (0.01)
Sensitivity Analysis 7: Pre/post comparison, excluding control group[j]	-0.033 (0.00)	-0.001 (0.00)	-0.031*** (0.01)	0.192*** (0.00)	0.002*** (0.00)	-0.071*** (0.01)

* p<0.05
** p<0.01
*** p<0.001

Notes:

[a] Other independent variables controlled for time trends (linear time trend, calendar month of observation), person-level characteristics (enrollee age at beginning of month; sex; race; ethnicity; dual eligible insurance status; SMI diagnoses; number of comorbid medical, mental health, and substance abuse conditions), and county-level characteristics (county unemployment rate, number of licensed psychiatrists per 100,000 population, and number of licensed adult psychiatric beds in general hospital psychiatric units/private psychiatric hospitals per 100,000 population) unless otherwise noted.

[b] Behavioral health-related ED visits were defined based on the presence of a mental health or substance abuse diagnosis listed anywhere in the ED visit record, with the exception of sensitivity analyses 1 and 2.
[c] Estimated using linear probability models, with standard errors estimated using 100 bootstrap replications.
[d] Estimated using hurdle models, with standard errors estimated using 100 bootstrap replications.
[e] Models excluded observations from February 2007 since waitlist policy was announced mid-month. Resulting sample sizes were 7,352,986 person-month observations (for models of any ED visits and number of ED visits), 1,388,174 ED visits (for model of ED length of stay), and 515,784 behavioral health-related ED visits (for model of behavioral health-related ED length of stay).
[f] Model of behavioral health-related ED length of stay (based on first-listed diagnoses) had reduced sample size of 260,131.
[g] Model of behavioral health-related ED length of stay (based on procedure codes) had reduced sample size of 135,419.
[h] Reduced sample sizes for models excluding people diagnosed with major depression were 5,243,949 person-month observations (for models of any ED visits and number of ED visits), 1,073,150 ED visits (for model of ED length of stay), and 439,672 behavioral health-related ED visits (for model of behavioral health-related ED length of stay).
[i] Models using adolescents as control group had sample sizes of 8,430,766 person-month observations (for models of any ED visits and number of ED visits), 1,480,343 ED visits (for model of ED length of stay), and 548,444 behavioral health-related ED visits (for model of behavioral health-related ED length of stay).
[j] Models excluding a control group had sample sizes of 7,172,660 person-month observations (for models of any ED visits and number of ED visits), 1,372,348 ED visits (for model of ED length of stay), and 510,555 behavioral health-related ED visits (for model of behavioral health-related ED length of stay).

Table 3.6: Average marginal effects of the waitlist policy on ED utilization by Medicaid enrollees with SMI, separately for treatment and control groups

Analysis scenario and group	Post-waitlist average marginal effect (standard error)[a]					
	All ED visits			Behavioral health-related ED visits[b]		
	Any visit in month, %[c] (n=7,459,847)	Number of ED visits in month[d] (n=7,459,847)	Length of ED visit, days[d] (n=1,406,090)	Any visit in month, %[c] (n=7,459,847)	Number of ED visits in month[d] (n=7,459,847)	Length of ED visit, days[d] (n=522,178)
Main Analysis: Defining post-waitlist period based on date of policy implementation						
Treatment group of adults aged 18-64	-0.017 (0.00)	-0.001 (0.00)	-0.031*** (0.01)	0.198*** (0.00)	0.002*** (0.00)	-0.071*** (0.01)
Control group of adults aged 65-74	-0.928*** (0.00)	-0.020*** (0.00)	-0.153*** (0.02)	-0.710*** (0.00)	-0.006*** (0.00)	-0.344*** (0.06)
Main Analysis: Defining post-waitlist period based on date of policy announcement[e]						
Treatment group of adults aged 18-64	-0.405*** (0.00)	-0.009*** (0.00)	-0.032** (0.01)	-0.462*** (0.00)	-0.007*** (0.00)	-0.054*** (0.01)
Control group of adults aged 65-74	-0.967*** (0.00)	-0.024*** (0.00)	-0.217*** (0.03)	-0.654*** (0.00)	-0.007*** (0.00)	-0.445*** (0.07)
Sensitivity Analysis 1: Defining "behavioral health-related" ED visits based on first-listed diagnoses[f]						
Treatment group of adults aged 18-64	--	--	--	-0.120*** (0.00)	-0.002*** (0.00)	-0.090*** (0.02)
Control group of adults aged 65-74	--	--	--	-0.534*** (0.00)	-0.005*** (0.00)	-0.342** (0.10)
Sensitivity Analysis 2: Defining "behavioral health-related" ED visits based on procedure codes[g]						
Treatment group of adults aged 18-64	--	--	--	0.008 (0.00)	0.000 (0.00)	-0.010* (0.00)
Control group of adults aged 65-74	--	--	--	0.006 (0.00)	-0.001 (0.00)	-0.019 (0.04)
Sensitivity Analysis 3: Including statewide psychiatric beds in state hospitals per 100,000 population as control variable						
Treatment group of adults aged 18-64	0.282*** (0.00)	0.006*** (0.00)	-0.005 (0.01)	0.553*** (0.00)	0.008*** (0.00)	-0.042** (0.01)
Control group of adults aged 65-74	-0.633** (0.00)	-0.016*** (0.00)	-0.092*** (0.02)	-0.360** (0.00)	-0.003** (0.00)	-0.236*** (0.06)
Sensitivity Analysis 4: Including regional psychiatric beds in state hospitals per 100,000 population as control variable						
Treatment group of adults aged 18-64	-0.055 (0.00)	-0.002 (0.00)	-0.031*** (0.01)	0.134** (0.00)	0.001** (0.00)	-0.071*** (0.01)
Control group of adults aged 65-74	-0.972*** (0.00)	-0.020*** (0.00)	-0.153*** (0.02)	-0.784*** (0.00)	-0.006*** (0.00)	-0.346*** (0.07)
Sensitivity Analysis 5: Excluding people with major depression from sample of Medicaid enrollees with SMI[h]						
Treatment group of adults aged 18-64	0.063 (0.00)	0.000 (0.00)	-0.035*** (0.01)	0.247*** (0.00)	0.003*** (0.00)	-0.071*** (0.01)
Control group of adults aged 65-74	-1.065*** (0.00)	-0.023*** (0.00)	-0.176*** (0.03)	-0.846*** (0.00)	-0.007*** (0.00)	-0.367*** (0.07)
Sensitivity Analysis 6: Using adolescents aged 13-17 years as control group[i]						
Treatment group of adults aged 18-64	0.029 (0.00)	-0.001 (0.00)	-0.031*** (0.01)	0.254*** (0.00)	0.002*** (0.00)	-0.071*** (0.01)
Control group of adolescents aged 13-17	-0.155 (0.00)	-0.001 (0.00)	0.003 (0.01)	-0.095 (0.00)	0.001* (0.00)	0.000 (0.01)

* p<0.05
** p<0.01
*** p<0.001
Notes:

[a] Other independent variables controlled for time trends (linear time trend, calendar month of observation), person-level characteristics (enrollee age at beginning of month; sex; race; ethnicity; dual eligible insurance status; SMI diagnoses; number of comorbid medical, mental health, and substance abuse conditions), and county-level characteristics (county unemployment rate, number of licensed psychiatrists per 100,000 population, and number of licensed adult psychiatric beds in general hospital psychiatric units/private psychiatric hospitals per 100,000 population) unless otherwise noted.

[b] Behavioral health-related ED visits were defined based on the presence of a mental health or substance abuse diagnosis listed anywhere in the ED visit record, with the exception of sensitivity analyses 1 and 2.

[c] Estimated using linear probability models, with standard errors estimated using 100 bootstrap replications.

[d] Estimated using hurdle models, with standard errors estimated using 100 bootstrap replications.

[e] Models excluded observations from February 2007 since waitlist policy was announced mid-month. Resulting sample sizes were 7,352,986 person-month observations (for models of any ED visits and number of ED visits), 1,388,174 ED visits (for model of ED length of stay), and 515,784 behavioral health-related ED visits (for model of behavioral health-related ED length of stay).

[f] Model of behavioral health-related ED length of stay (based on first-listed diagnoses) had reduced sample size of 260,131.

[g] Model of behavioral health-related ED length of stay (based on procedure codes) had reduced sample size of 135,419.

[h] Reduced sample sizes for models excluding people diagnosed with major depression were 5,243,949 person-month observations (for models of any ED visits and number of ED visits), 1,073,150 ED visits (for model of ED length of stay), and 439,672 behavioral health-related ED visits (for model of behavioral health-related ED length of stay).

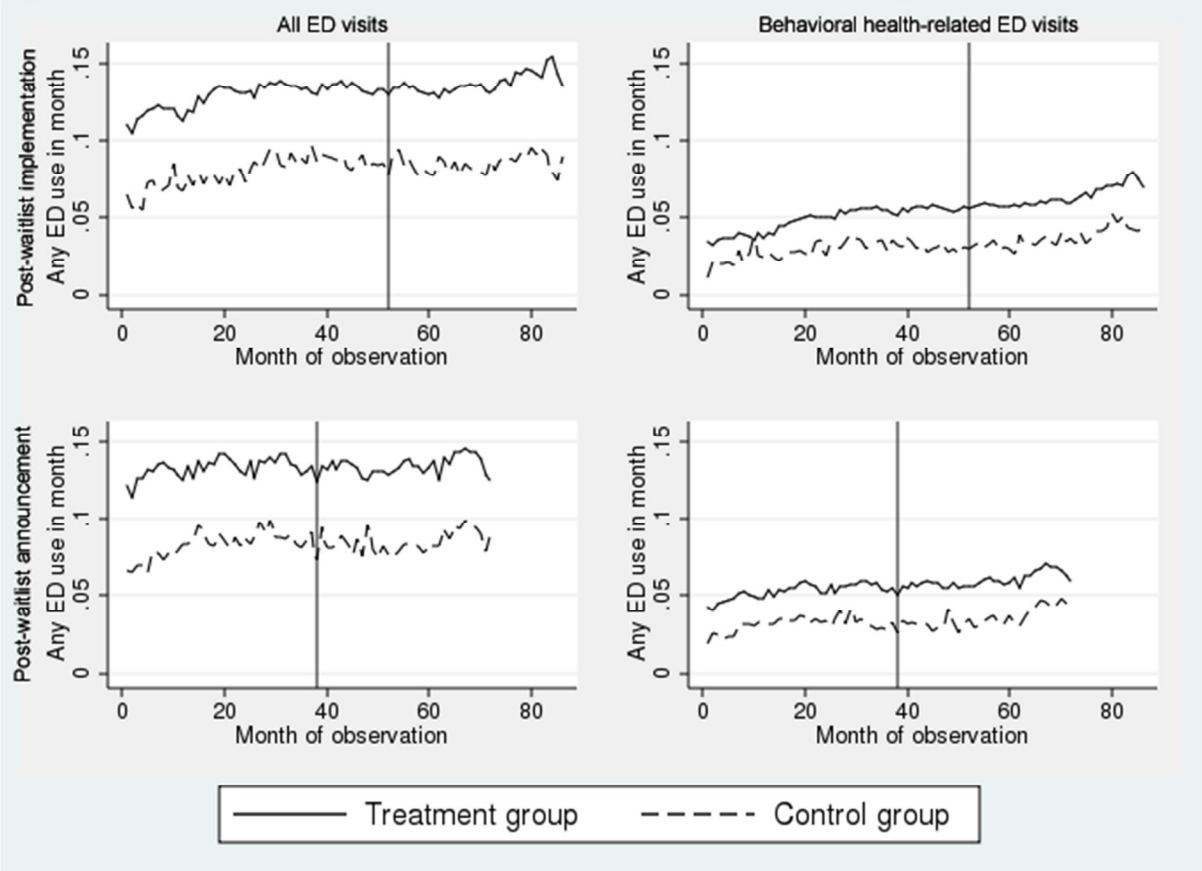
[i] Models using adolescents as control group had sample sizes of 8,430,766 person-month observations (for models of any ED visits and number of ED visits), 1,480,343 ED visits (for model of ED length of stay), and 548,444 behavioral health-related ED visits (for model of behavioral health-related ED length of stay).

Table 3.7: Predicted ED utilization outcomes pre- and post-waitlist by Medicaid enrollees with SMI[a]

	Predicted value (95% confidence interval)					
	All ED visits			Behavioral health-related ED visits[b]		
	Any visit in month, %	Number of ED visits in month	Length of ED visit, days	Any visit in month, %	Number of ED visits in month	Length of ED visit, days
Treatment group of adults aged 18-64						
Pre-waitlist	13.332 (13.226-13.438)	0.191 (0.189-0.193)	0.144 (0.131-0.157)	5.373 (5.310-5.437)	0.068 (0.067-0.069)	0.230 (0.204-0.256)
Post-waitlist	13.314 (13.140-13.489)	0.190 (0.187-0.193)	0.112 (0.100-0.123)	5.572 (5.460-5.683)	0.070 (0.069-0.071)	0.154 (0.142-0.167)
Control group of adults aged 65-74						
Pre-waitlist	16.604 (16.220-16.988)	0.259 (0.248-0.270)	0.117 (0.100-0.134)	6.621 (6.403-6.839)	0.083 (0.077-0.089)	0.212 (0.176-0.247)
Post-waitlist	15.676 (15.170-16.181)	0.221 (0.209-0.233)	0.075 (0.063-0.086)	5.908 (5.601-6.215)	0.070 (0.065-0.075)	0.120 (0.100-0.140)

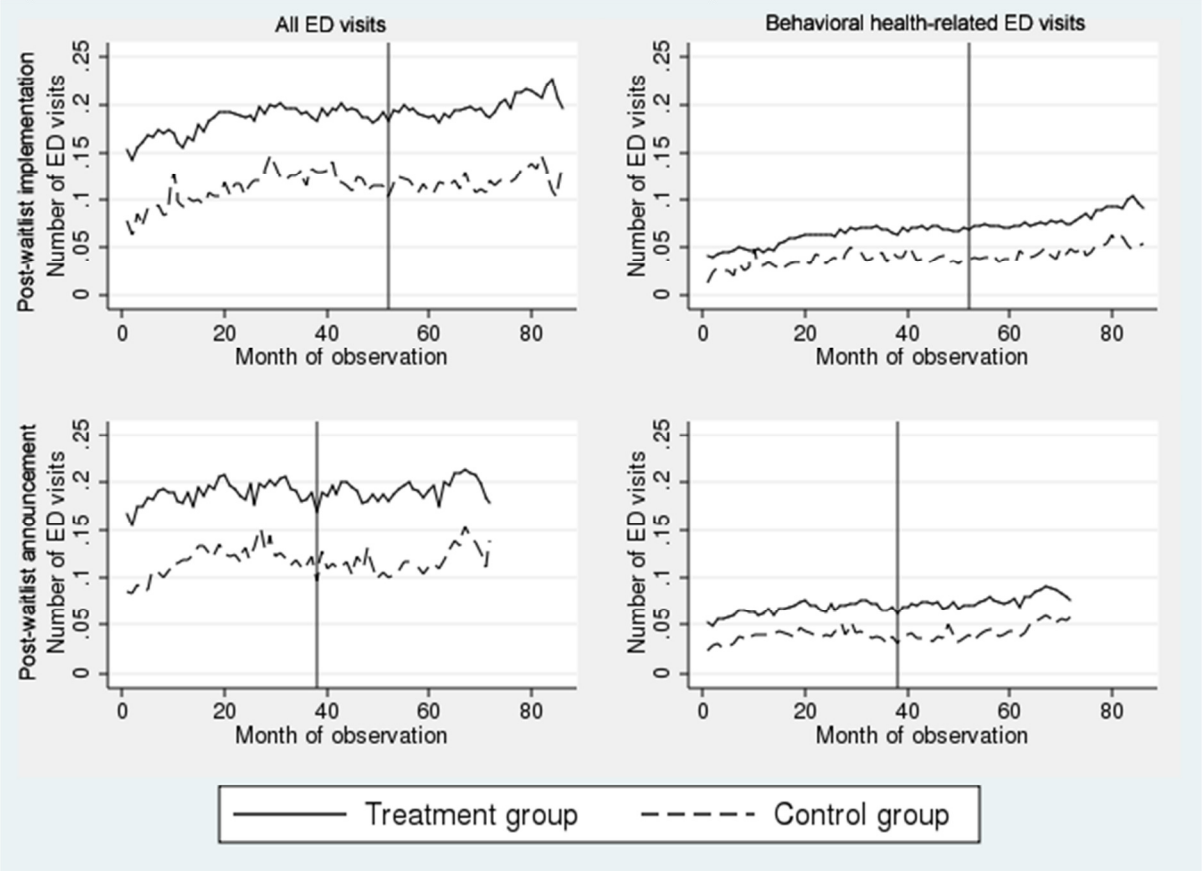
Notes:
[a] Predictions are based on results from main analysis models, defining the post-waitlist period based on date of waitlist implementation. Standard errors were estimated using the delta method, with 95% confidence intervals reported in parentheses.
[b] Behavioral health-related ED visits were defined based on the presence of a mental health or substance abuse diagnosis listed anywhere in the ED visit record.

Figure 3.1: Time series plots of the proportion of Medicaid enrollees with any ED use in each month



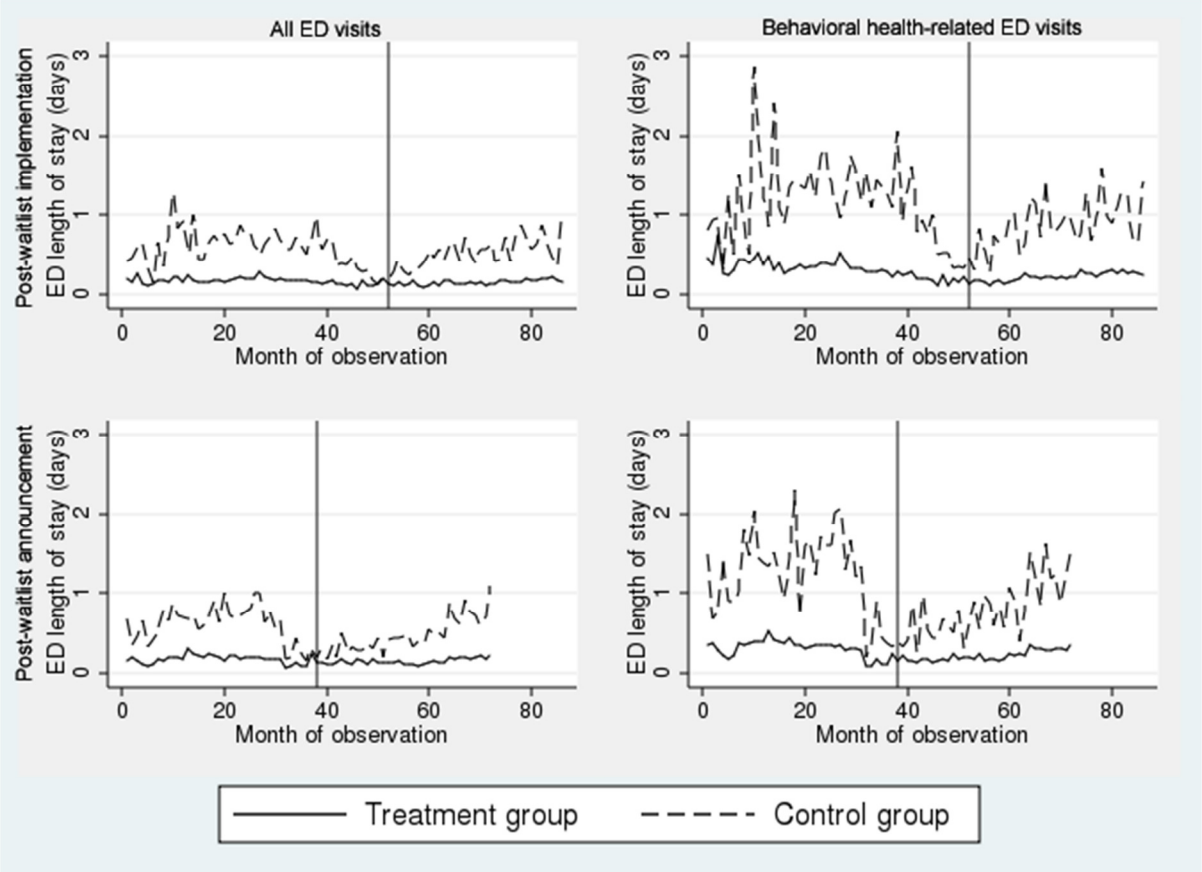
Note: Vertical lines at month 52 in the top panels indicate month of waitlist policy *implementation* (start and end of time series only contains data from certain state hospital regions; see Appendix A for more details). Vertical lines at month 38 in the bottom panels indicate month of statewide policy *announcement*. Panels on the left include all ED visits; panels on the right include behavioral health-related ED visits based on the presence of a behavioral health diagnosis anywhere in the ED visit claim.

Figure 3.2: Time series plots of the mean number of monthly ED visits per Medicaid enrollee



Note: Vertical lines at month 52 in the top panels indicate month of waitlist policy *implementation* (start and end of time series only contains data from certain state hospital regions; see Appendix A for more details). Vertical lines at month 38 in the bottom panels indicate month of statewide policy *announcement*. Panels on the left include all ED visits; panels on the right include behavioral health-related ED visits based on the presence of a behavioral health diagnosis anywhere in the ED visit claim.

Figure 3.3: Time series plots of the monthly mean length of stay for ED visits



Note: Vertical lines at month 52 in the top panels indicate month of waitlist policy *implementation* (start and end of time series only contains data from certain state hospital regions; see Appendix A for more details). Vertical lines at month 38 in the bottom panels indicate month of statewide policy *announcement*. Panels on the left include all ED visits; panels on the right include behavioral health-related ED visits based on the presence of a behavioral health diagnosis anywhere in the ED visit claim.

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CHAPTER 4

EXTERNAL EFFECTS BY REGION OF A STATE PSYCHIATRIC HOSPITAL WAITLIST POLICY ON EMERGENCY DEPARTMENT USE

INTRODUCTION

State-operated psychiatric hospitals in most states are managed by a unit of state government that sets their operating procedures, staffing patterns, and clinical policies. In practice, however, the uniformity implied by this management structure is differentiated by the distinctive characteristics of the regions served by individual hospitals including demographics and alternative services ecology. The net result is that policies promulgated centrally at the state-level may have different consequences for individual hospitals as a function of these regional variations. This is the situation examined in this study, which focuses on waitlist policies adopted by state government and their impact on utilization of general hospital emergency departments (EDs) in the regions served by four state psychiatric hospitals in North Carolina.

In 2012, 21 state mental health agency directors reported placing patients on waitlists for inpatient services (National Association of State Mental Health Program Directors (NASMHPD) Research Institute, Inc., 2012). These waitlists are used at state psychiatric hospitals in particular, where people in psychiatric crisis can wait for days, weeks, or even months before being admitted to a state hospital (Keefe, 2013; Rosenthal, 2013; Timmins, 2012; Torrey et al., 2012; Judd, 2010; Torrey et al., 2008). Prior to implementing waitlists, state hospitals operated overcrowded treatment units, which resulted in patients receiving inadequate care, as well as difficulties related to hospital accreditation and staff recruitment (Appelbaum, 1991).

Although waitlists help to prevent overcrowding, they fail to address the needs associated with excess demand. As a result, the burden to provide inpatient psychiatric care may be shifting post-waitlist to other agencies in the mental health system. People in need of care who are unable to receive immediate admission to state hospitals may increasingly find themselves in jails, prisons, and

EDs. These locations are now facing the same problems controlling admissions that state hospitals once faced. Under the Emergency Medical Treatment and Active Labor Act (EMTALA), for example, patients in psychiatric crises who present to EDs must be (1) stabilized prior to discharge or (2) transferred to an inpatient bed for further treatment.

In 2007, approximately 12.5% of all ED visits nationally, or 12 million ED visits, included a mental health or substance abuse diagnosis (Owens et al., 2010). Research is needed to determine whether changes in mental health systems are contributing to this ED utilization, particularly since EDs are not therapeutic environments and may have difficulties caring for psychiatric patients in crisis (Zun, 2012; Tuttle, 2008; Stefan, 2006). Several recent studies have evaluated the effects of psychiatric bed closures on patterns of ED utilization (Shumway et al., 2012; Little et al., 2011; Bastiampillai et al., 2010; Lindrooth, 2007). However, only one study has examined the effects of state hospital waitlists on ED utilization (La et al., working paper). This study found that North Carolina's waitlists were associated with relatively small increases in the frequency and length of stay of ED visits by Medicaid enrollees with severe mental illness (SMI), although uncertainties remain as to whether effects varied by state hospital region.

Building on the prior study by La and colleagues (working paper), the current study draws on the experience of North Carolina to better understand the regional effects of state hospital waitlists on ED utilization. Over ten years ago, North Carolina enacted a Mental Health Reform Bill (House Bill 381, 2001) in an effort to downsize state hospitals and shift care to community settings (Swartz and Morrissey, 2003; Vicario 2012). In the 5 years following reform, state hospital capacity decreased by more than 30% (White, 2012), although reliance on state hospitals for acute psychiatric care persisted. By fiscal year 2007, the state had the highest absolute number of state hospital admissions (17,419 vs. a mean of 3,203 across all other reporting states) and one of the highest rates of admissions after adjusting for population (196.7 admissions per 100,000 population vs. a mean of 57.7 admissions per 100,000 population) (Center for Mental Health Services, 2007).

North Carolina's Division of Mental Health, Developmental Disabilities and Substance Abuse Services ultimately announced a statewide waitlist policy on February 6, 2007 (Bonner 2007; Moseley, 2007). The policy was created to address concerns about patient and staff safety when

hospitals operated over capacity, as well as to maintain federal funding from the Centers for Medicare and Medicaid Services after cited incidents at the hospitals (Swartz and Morrissey, 2012; Coletti, 2008).

Following the policy announcement, the number of state hospital admissions decreased from 17,419 admissions in fiscal year 2007 to 13,570 admissions in fiscal year 2008, a relative decline of 22% (Center for Mental Health Services, 2007; Center for Mental Health Services, 2008). By 2008, nearly 350 patients were placed on a waitlist for state hospital admission each month (on average, according to state hospital waitlist data). These people waited for an average of 19 hours, although in some cases, patients waited for over a week for admission. Approximately 55% of waitlisted patients were not admitted to state hospitals even though the patients met requirements for admission (i.e., these patients were deemed a threat to themselves or others). Among those not admitted to a state hospital, 21% were sent home from their referral location and 27% had dispositions that were unknown.

Despite the large backlog of patients waiting for state hospital admission, the study by La and colleagues (working paper) found that state hospital waitlists were associated with relatively small increases in ED utilization by Medicaid enrollees with SMI statewide. However, as shown in Figure 4.1, North Carolina's 100 counties are divided into four distinct state hospital regions. These regions vary substantially in the demographic characteristics and the availability of local mental health services available to patients. Understanding differences in the effects of the waitlist policy taking into account the distinct characteristics of each region will provide further insights on heterogeneity in the response to the waitlist. If the external effects of the waitlist policy are in fact conditioned on regional variations in state hospital catchment areas, these findings would have implications for the creation and implementation of mental health service policies and interventions. For example, results could highlight the need to consider local area differences before implementing broad, sweeping policies at the state-level, taking a more proactive approach to anticipate differential effects by local areas, and if possible, tailor policies to these local areas.

The objective of the current study was to determine whether the effects of the waitlist policy on frequency and length of stay of ED visits were greater in certain state hospital regions. The

waitlist policy's effects were expected to be larger in the Western and South Central regions of the state. State hospital waitlist data indicated that these regions started delaying admissions in the same month that the policy was announced, potentially signaling a greater reliance on waitlists to control state hospital admissions and a greater reliance on EDs to provide care for waitlisted patients. In contrast, hospitals in the North Central and Eastern regions began using waitlists in March 2007 and April 2008, respectively. Here, delayed uptake of waitlists may signal that these regions had smaller demand populations or a greater availability of alternate mental health services.

METHODS

Data

North Carolina Medicaid data from the University of North Carolina's Carolina Cost and Quality Initiative (CCQI) were used to examine the frequency and length of stay of ED visits for people with SMI (http://www.shepscenter.unc.edu/data/ccqi-carolina-cost-and-quality-initiative/). CCQI offers de-identified archived data from the state's Medicaid system and State Employees Health Plan. The data used in the current study included information on all Medicaid reimbursed health care services within the state for people with administrative diagnoses of schizophrenia, bipolar disorder, or major depression. The data were retrieved on two separate occasions, resulting in a final sample of Medicaid enrollees with at least one of the diagnoses between January 1, 2004 and December 31, 2007 and Medicaid enrollees with at least one of the diagnoses between January 1, 2008 and December 31, 2009.

State psychiatric hospital waitlist data from the state's Division of State Operated Healthcare Facilities (DSOHF) were used to determine the date of waitlist implementation for each state hospital. The data contain monthly counts of the number of patients placed on a waitlist at each hospital, as well as the number of days each hospital operated on a waitlist. The data are collected by each hospital and reported to DSOHF for statewide monitoring.

Several additional data sources were used to control for unemployment rates and availability of mental health resources in the study's main analyses. The Bureau of Labor Statistics provided monthly county-level unemployment rates over the study period (Bureau of Labor Statistics, 2012). Increases in area unemployment rates have previously been linked to several factors which may

affect patterns of ED utilization, including decreases in rates of insurance (Cawley et al., 2013; Cawley and Simon, 2005) and use of preventive care services (Tefft and Kageleiry, 2013), as well as increases in rates of potentially avoidable emergency admissions (O'Cathain et al., 2013) and psychiatric hospitalizations (Fortney et al., 2007; Kammerling and O'Connor, 1993). North Carolina's Health Professions Data System provided data on the number of licensed psychiatrists in each county (North Carolina Health Professions Data System, 2004-2010). Similarly, North Carolina's annual State Medical Facilities Plans provided data on the number of licensed adult psychiatric beds in private psychiatric hospitals and general hospital psychiatric units (North Carolina Division of Health Service Regulation, 2004-2010). Population estimates from the U.S. Census Bureau were used to adjust both of the mental health resource control variables so that they accounted for resources per 100,000 population (U.S. Census Bureau, 2010).

Three additional data sources were also used in sensitivity analyses to control for state hospital bed capacity over the study period. Annual estimates of the number of beds in operation at each state hospital were obtained from the American Hospital Association's Guides to the Health Care Field (AHA, 2003-2009) and the Centers for Medicare and Medicaid Services' Hospital Cost Reports (CMS, 2004-2009). Both of these sources were used because neither source had complete data over the entire study period. For example, the AHA Guides relied on previous year's estimates when hospitals did not self-report, which resulted in measurement error for some hospitals (e.g., closed hospitals in the state continued to have operating capacity reported). Similarly, data from certain hospitals in the Cost Reports were suspicious. A single measure of regional state hospital capacity was created by combining data from the AHA Guides and Cost Reports, using the source that best matched author expectations of annual capacity in each hospital. As a third source, annual estimates of statewide operating capacity were also obtained from the state's DSOHF (White, 2012). Separate estimates for each state hospital were not available from DSOHF. For all three sources, linear interpolation was used to smooth capacity changes throughout each year.

Sample

The final sample included all Medicaid enrollees with at least one inpatient visit or two outpatient visits containing a diagnosis of SMI between 2004 and 2009. Here, SMI diagnoses were

identified based on the presence of ICD-9-CM codes corresponding to schizophrenia, other nonorganic psychoses, bipolar disorder, or major depression (ICD-9-CM codes 295, 296, and 298, excluding 298.2). Enrollees who were partially dual eligible for Medicaid and Medicare (n=39,535) were excluded from the study since ED visits paid fully by Medicare were not included in Medicaid claims. Enrollees who were fully dual eligible for Medicaid and Medicare were included in the study since the claims data included the portions of their episodes of care that were paid for by Medicaid. Regardless of dual eligibility status, enrollees living in a five-county region with a Medicaid behavioral health carve-out program (n=97,167 enrollees in Cabarrus, Davidson, Rowan, Stanly, or Union counties) were also excluded since episodes of care with a primary diagnosis of behavioral health were not included in the Medicaid data.

Changes in the frequency of ED visits pre- and post-waitlist were analyzed at the person-month level. In an effort to minimize the risk of missing ED visits that occurred during periods of lapsed Medicaid coverage, person-month observations for people who were Medicaid eligible for less than 90% of the month were excluded from the study. It should be noted that this exclusion criterion may still result in an underestimate of ED utilization, particularly if general hospitals frequently identify uninsured people who are Medicaid-eligible and enroll these people in Medicaid during their ED visits.

In main analyses, person-month observations were included for people who were aged 18 to 64 years at the beginning of the month (treatment group) or people who were aged 65 to 74 years at the beginning of the month and not in a skilled nursing facility (control group). By creating the treatment and control groups based on age of enrollees at the beginning of each month, people were able to age into the control group. As an alternate control group, sensitivity analyses included people who were aged 13 to 17 years at the beginning of the month. In all analyses, the treatment and control groups were selected based on state hospital waitlist data and conversations with state hospital administrators, which indicated that the adult treatment units operated on a waitlist more often than geriatric or child/adolescent treatment units. For example, waitlist data from 2008 revealed that nearly 90% of patients admitted to a state hospital from a waitlist were admitted to adult treatment units, as compared to only 1% admitted to geriatric treatment units and 1% admitted to child and adolescent treatment units.

The final person-month sample included nearly 7.5 million observations between 2004 and 2009. These observations were divided into state hospital catchment regions based on enrollee county of residence. Broughton Hospital's catchment region had the largest number of observations (n=2,631,564; 35.3% of all observations), followed by Cherry Hospital (n=1,873,568; 25.1%), Central Regional Hospital (n=1,504,841; 20.2%), and Dix Hospital (n=1,449,874; 19.4%).

Changes in ED visit length of stay pre- and post-waitlist were analyzed at the visit-level. The sample of visit-level observations captured all ED visits from the person-month file, including additional information on the length of stay of individual ED visits. The final visit-level sample included over 1.4 million ED visits. These observations were split between Broughton (n=552,837; 39.3% of all ED visits), Cherry (n=327,211; 23.3%), Central Regional (n=270,801; 19.3%), and Dix (n=255,241; 18.2%) catchment regions.

Measures

Dependent variables in the study included a binary indicator of whether there were any ED visits in each month, a count of the number of ED visits each month, and ED length of stay. Outpatient and inpatient ED visits were identified in the claims data using category of service, procedure, and revenue codes corresponding to ED visits (category of service code 50, procedure codes 99281-99285, and revenue codes RC450-RC452, RC456, RC459). Length of stay (in days) was calculated by subtracting the date of ED admission from the date of ED discharge; thus stays with same day discharges were coded as having a length of stay of zero days.

Four different ED visit specifications were used in the study. Main analyses included (1) all ED visits and (2) all ED visits with a mental health or substance abuse diagnosis code listed anywhere in the ED visit record (i.e., "behavioral health-related" ED visits). The behavioral health-related definition may *understate* actual ED visits by people with SMI if providers do not consistently include behavioral health diagnoses in claims, while the definition may *overstate* actual ED visits by people with SMI if providers report behavioral health diagnoses even if visits are unrelated to these diagnoses. Sensitivity analyses used two additional behavioral health-related ED visit specifications. The first specification included all ED visits with a mental health or substance abuse diagnosis code listed first in the ED visit record. The second specification included all ED visits with a mental health

or substance abuse screening, medication management, or medication injection procedure code occurring on the same date as an ED visit, regardless of diagnoses. The diagnosis and procedure codes used to identify behavioral health-related ED visits are provided in Table 4.1.

The study's key independent variables included a binary indicator of whether the observation was pre- or post-waitlist and an interaction between this post-waitlist indicator and a linear time trend. The post-waitlist period was defined based on date of waitlist *implementation* and date of policy *announcement*. Date of waitlist implementation was operationalized as the first day of the first month when each state hospital operated on a waitlist for at least five days. Date of policy announcement was February 6, 2007. In this definition, the pre-waitlist period included all observations between January 2004 and January 2007 and the post-waitlist period included all observations between March 2007 and December 2009. Observations from February 2007 were excluded from analyses since the waitlist policy was announced in the middle of the month. The two key independent variables were also interacted with a binary indicator for whether the observation was from the treatment group. These interaction terms were needed to provide estimates of the waitlist's effects using the study's difference-in-difference approach.

Other independent variables controlled for linear time trends, seasonality, as well as county- and person-level characteristics. County-level characteristics included unemployment rate and the availability of alternative mental health services (number of licensed psychiatrists per 100,000 population and number of licensed adult psychiatric beds in private psychiatric hospitals and general hospital psychiatric units per 100,000 population). Person-level characteristics included age at the beginning of each month, sex, race (white, black, other minority, unknown), ethnicity (non-Hispanic, Hispanic, unknown), insurance status (fully dual eligible for Medicare/Medicaid vs. not dual eligible), and SMI diagnosis (ever diagnosed with schizophrenia or other nonorganic psychoses, ever diagnosed with bipolar disorder, and ever diagnosed with major depression). Number of medical, mental health, and substance abuse comorbidities ever diagnosed were also included, as defined in Table 4.2.

Main Analysis

Descriptive and time trend analyses were used to examine pre- and post-waitlist differences in the proportion of person-month observations with any ED visits, the mean number of ED visits in each month, and the mean ED visit length of stay separately for each state hospital region. A difference-in-difference approach was further used to estimate the effects of the waitlists on the study's outcomes separately for each state hospital. Twelve main regression models were estimated for each of the four state hospitals. These twelve models corresponded to the study's three outcome variables (any ED visits in month, number of ED visits in month, and ED length of stay), with two ED visit specifications (all ED visits and behavioral health-related ED visits), and two post-waitlist period definitions (based on date of waitlist implementation and based on date of policy announcement). In each of the models, the pre- and post-waitlist difference in the outcome variable for the treatment group of Medicaid enrollees aged 18 to 64 years was compared to the difference in the outcome variable for the control group of Medicaid enrollees aged 65 to 74 years who were not in an SNF. This control group was selected based on results from preliminary analyses that indicated similar pre-waitlist trends for most outcome variables in the treatment and control groups (Figures 4.2-4.5), with the exception of ED length of stay (Figures 4.6 and 4.7).

Linear probability models were used to examine the effects of waitlists on whether enrollees had any ED visits in each month. Although results from these models are easier to interpret than other binary outcome models, a main limitation of linear probability models is that they can produce predicted probabilities that are less than zero or greater than one. In most of the study's main models, fewer than 6% of predicted probabilities were out-of-range, with a maximum of 14% out-of-range predictions.

Hurdle models were used to examine the effects of waitlists on the number of ED visits in a given month and ED visit length of stay. These models were needed to account for zero-inflation within the count outcomes. Statewide, 86.8% of person-month observations did not have any ED use and 96.7% of ED visits had a length of stay of zero days (i.e., were admitted and discharged from the ED on the same date). In all hurdle models, the first part of the model was a logit model estimating whether the count was greater than zero and the second part of the model was an ordinary least

squares model estimating the count for non-zero counts only. As an example, the model of ED length of stay included all ED visits in the first part of the model estimating whether length of stay was greater than zero days and included ED visits with a non-zero length of stay in the second part of the model estimating the length of stay for stays greater than zero days.

Sensitivity Analyses

In addition to the main analyses, several sensitivity analyses were also conducted to determine whether results were robust to other model specifications. The first two sensitivity analyses used the alternative definitions for "behavioral health-related" ED visits. The third and fourth sensitivity analyses included control variables for the number of state hospital beds in operation per 100,000 population statewide and regionally to examine whether main analysis estimates may have been biased as a result of excluding these variables. The fifth sensitivity analysis limited the sample of Medicaid enrollees with SMI to people ever diagnosed with schizophrenia, other nonorganic psychoses, or bipolar disorder, excluding people only diagnosed with major depression.

The sixth sensitivity analysis used an alternate control group of adolescents aged 13 to 17 years. This control group had similar pre-waitlist trends for ED utilization outcomes as compared to the treatment group. However, even though state hospital waitlist data indicated that adolescents were not frequently placed on state hospital waitlists, reports noted that state-run inpatient services for people under age 18 may have been equally as strained as those services for adults (Disability Rights North Carolina, 2011; Duda and Rash, 2011). Due to these reports, the control group of adolescents was used in sensitivity analyses rather than the study's main analysis.

The study's seventh sensitivity analysis used a pre-post comparison of outcome variables rather than a difference-in-difference approach. This sensitivity analysis was included since neither the geriatric or adolescent control groups exactly match the trends during the pre-intervention period.

In all of the study's models, clustered standard errors were used to account for multiple observations for each enrollee over time. Individual-level fixed effects were investigated, but were ultimately not included since pooled models produced similar results. Average marginal effects with standard errors estimated using 100 bootstrap replications and predicted values with 95% confidence intervals are reported in results for ease of interpretation. Average marginal effects are also reported

for the treatment and control groups separately in Appendix B. All analyses were conducted using Stata version 12.1 (College Station, Texas) with an alpha level of 0.05. Alpha levels of 0.01 and 0.001 are also reported to account for the study's large sample size. The study was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill.

RESULTS

Sample characteristics for each of the state hospital regions are provided in Table 4.3. For the most part, the distributions of person-month characteristics across hospital regions were similar, with less than five percentage points separating the minimum and maximum values across regions. The majority of observations were for people who were female, non-Hispanic, and not dual-eligible for Medicare. However, observations from the Western region of the state (Broughton's catchment area) were less racially diverse (74.8% white and 21.4% black) as compared to observations from the other three regions (range of 46.9-50.0% white and 41.1-48.8% black). In addition, SMI diagnoses varied somewhat across regions, with 35.3-42.3% ever diagnosed with schizophrenia or other nonorganic psychoses, 46.4-57.7% ever diagnosed with bipolar disorder, and 65.3-68.3% ever diagnosed with major depression. Mean age and number of diagnosed comorbid conditions were similar across regions.

The majority of ED visits by Medicaid enrollees with SMI were not behavioral health-related. Using the least restrictive definition of behavioral health-related visits, the percent of all ED visits that were behavioral health-related ranged from 32.8% in the Eastern region to 42.6% in the Western region of the state (Cherry and Broughton catchment regions, respectively). A smaller share of ED visits was considered behavioral health-related when defined based on first-listed diagnoses (18.2-19.6% of all ED visits across regions) and procedure codes (9.1-10.5% of all ED visits across regions).

Similar to results from the statewide analysis, unadjusted ED utilization outcomes displayed limited differences pre- and post-waitlist implementation in each of the state hospital regions (Table 4.4). The treatment group within the Eastern region (Cherry) experienced the greatest increase in the percent of person-month observations with any ED visits post-waitlist implementation (0.6 percentage point increase for all ED visits, $p<0.001$; 1.1, 0.4, and 0.5 percentage point increase for behavioral

health-related ED visits using the study's three behavioral health definitions). However, the post-waitlist increases were also relatively large for the Eastern region's control group (1.3, 1.0, 0.5, and 0.3 percentage point increases, respectively, all at $p<0.001$). Using the least restrictive definition for behavioral health-related ED visits, the South Central region's (Dix's) treatment group experienced a 1.2 percentage point increase in the percent of observations with any behavioral health-related ED visits ($p<0.001$), while post-waitlist effects were smaller for the Western and North Central regions (0.4 percentage point increases each, both at $p<0.001$). Using this same definition, the relative change in the percent of person month observations with any behavioral health-related ED visits ranged from 6.2% and 7.1% in the Western and North Central regions, respectively, to 26.4% and 27.6% in the Eastern and South Central regions, respectively. Time series plots in Figures 4.2 and 4.3 provide additional detail on the percent of observations with any ED visits (overall and using the least-restrictive definition for behavioral health-related) by hospital region. From these figures, there do not appear to be any major shifts in the outcome variables that coincide with the date of waitlist implementation. However, in Figure 4.3, relatively stable trends in the treatment groups of the Western and North Central regions (Broughton and Central Regional's catchment areas) can be contrasted with general increases in the percent of observations with any behavioral health-related ED visits for the Eastern and South Central regions (Cherry and Dix's catchment areas).

In each of the state hospital regions, mean number of ED visits per person-month observation did not change by any clinically meaningful amount post-waitlist implementation. Table 4.4 shows that the mean number of overall and behavioral health-related ED visits changed post-waitlist by less than 0.02 visits in each of the region's treatment and control groups. Figures 4.4 and 4.5 further highlight limited changes in the mean number of ED visits per enrollee over the study period. However, general increases in the mean number of behavioral health-related ED visits can again be noted in Figure 4.5 for the Eastern and South Central regions (Cherry and Dix).

Post-waitlist changes in mean ED length of stay were also minor (Table 4.4). For the treatment group, mean length of stay decreased post-waitlist implementation by 0.03 days in the North Central and South Central regions ($p=0.002$ and $p=0.004$, respectively); post-waitlist decreases in the Western and Eastern regions were not statistically significant at an alpha level of 0.05. Post-

waitlist decreases in mean ED length of stay for behavioral health-related ED visits in treatment groups were slightly larger, ranging from 0.04 in the Western region to 0.14 in the South Central region (all statistically significant at $p<0.001$, using the least restrictive definition for behavioral health-related ED visits). Relatively flat trends in ED length of stay for the treatment groups in each hospital are also shown in Figures 4.6 and 4.7. In these figures, longer ED stays in the control groups highlight a potential limitation of the Medicaid data, which may be erroneously assigning part of geriatric patients' inpatient hospital stays to the ED visit. For all ED utilization outcomes, similar unadjusted results were found when the post-waitlist period was defined based on date of policy announcement (not reported here).

Results from the study's regression models are provided in Tables 4.5, 4.6, and 4.7, corresponding to the study's three main outcome variables. From these results, there do appear to be some regional differences in the effects of waitlists on ED utilization, although all effects are still relatively small. For example, the average marginal effect of waitlist policy announcement on the probability of having any ED visits in a given month ranged from no difference in the Eastern, Western, and South Central regions to a 1.2% increase in the North Central region ($p<0.05$, as shown in Table 4.5). Results were not significant in any of the regions when the post-waitlist period was defined based on date of policy announcement, although this may be a function of only using 100 bootstrap replications to estimate standard errors. Results were also generally consistent across sensitivity analyses (based on the direction and magnitude of results), although results were sensitive to the control groups used in analyses (sensitivity analyses 3-7 in Table 4.5).

The average marginal effects of waitlist implementation on the probability of having any behavioral health-related ED visits in a given month had similarly small variations across regions. The effects of waitlists were generally not significant in the study's main models, although waitlist policy announcement was associated with a 0.7% increase in the probability of any behavioral health-related ED visits in a given month for the South Central region ($p<0.05$). The largest magnitude of effects across all models was a 1.2% increase in the probability of any behavioral health-related ED visits in the South Central region when people with major depression were excluded from analyses ($p<0.01$, from Sensitivity Analysis 5 in Table 4.5). Again, these findings were sensitive to the control

group used in analyses. When adolescents were used as a control group or when no control group was used, the effects of waitlists on behavioral health-related ED use in all regions were either not statistically significant or were negative.

Differences across state hospital regions in the effects of waitlists on the number of ED visits (Table 4.6) were also small. For number of overall ED visits, post-waitlist implementation effects ranged from no effects to a 0.025 increase in the South Central region ($p<0.05$). Average marginal effects on number of behavioral health-related ED visits ranged from no difference to a 0.010 increase in the South Central region ($p<0.01$), with even smaller effects using the alternate behavioral health-related ED visits definitions. Results were generally consistent when the waitlist period was defined based on date of policy announcement. Results were also similar using other model specifications in sensitivity analyses, with all models indicating minor effects of waitlists on expected number of ED visits in a given month.

Waitlists were associated with no change or increases in ED length of stay across hospital regions, although these findings were sensitive to the control group used in analyses. Effects of waitlist implementation on length of stay for all ED visits ranged from no difference in three regions to a 0.222 day increase in ED length of stay in the Western region ($p<0.01$). The magnitude of these effects were typically larger for behavioral health-related ED visits, with effects of waitlist implementation ranging from no difference in the Eastern and South Central regions to a 0.366 day increase in the Western region ($p<0.001$). Effects of waitlist policy announcement on behavioral health-related ED length of stay ranged from no difference in the Eastern region to a 0.563 day increase in the South Central region ($p<0.05$).

To further ease interpretation of these results, predicted values of all ED utilization outcomes are provided in Table 4.8. Pre- and post-waitlist changes in predicted values for each hospital's treatment groups were generally minor, with most groups experiencing either no change or a decrease in predicted values.

DISCUSSION

Results from the current study were only partially consistent with the hypotheses that waitlists differentially affected ED use by Medicaid enrollees with SMI in certain regions. Similar to the

previous study by La and colleagues (working paper), results from difference-in-difference models using older adults as a control group indicated that the policy's effects were still generally small increases in outcomes across all state hospital regions. Effects of waitlist policy announcement on the probability of any ED visits in a given month ranged from 0-1.2% across regions for all ED visits and 0-0.7% across regions for behavioral health-related ED visits. Effects of waitlists on ED length of stay also ranged from 0-0.260 day increases for all ED visits and 0-0.563 day increases for behavioral health-related ED visits across regions.

Somewhat surprisingly, the effect of waitlists on the probability of any ED visits in a given month was not greatest in the Western region, even though this region began to delay state hospital admissions immediately after policy announcement. These results were consistent in unadjusted and adjusted results. However, from unadjusted results, the Western region had the highest percent of observations with any behavioral health-related ED visits in both the pre- and post-waitlist time periods, suggesting that the region may have had less room for post-waitlist increases. These findings may also be a reflection of limited local psychiatric resources in the region, including beds and psychiatrists. From adjusted analyses, the waitlist's effects on probability of any ED visits in a given month were greatest in the South Central and North Central regions of the state, potentially indicating that these regions were less able to manage waitlisted patients experiencing psychiatric crises or were more affected by other factors influencing ED utilization. Additional research is needed to determine whether these catchment areas had fewer resources (other than general hospital EDs) that were available to stabilize patients in psychiatric crisis within their communities.

Effects of the waitlists on the mean number of ED visits in each month did not vary across regions by any clinically meaningful amount. However, average marginal effects on ED length of stay did vary across regions. Here, effects of waitlists on ED length of stay were relatively larger in the Western region of the state as compared to other regions. Effects were generally the smallest in the Eastern region of the state. These findings were consistent with the study's hypotheses and may indicate that the Eastern region was able to avoid operating on a waitlist for over one year post-announcement and also keep patients with behavioral health diagnoses moving through the region's EDs.

Results should be interpreted taking into account several limitations of the study. First, analyses examined ED utilization through year 2009, or slightly less than three years post-waitlist announcement, in a population of North Carolina Medicaid enrollees with SMI. Reports from the state's DSOHF indicate that state hospital waitlists have grown in more recent years (North Carolina Division of State Operated Healthcare Facilities, 2012; North Carolina Division of State Operated Healthcare Facilities 2013). In fiscal years 2012 and 2013, approximately 580 people in EDs were placed on a state hospital waitlist each month, with a mean wait time of more than 68 hours. It is possible that the effects of continued backlogs in state hospital admissions are only now being realized. Similarly, the effects of waitlists on ED utilization may be greater for other patient populations, such as people who are uninsured or diagnosed with other mental health and substance abuse diagnoses. A recent study by Hakenewerth and colleagues (2013) examined all ED visits in North Carolina, regardless of payer source, and found that the annual number of ED visits increased by 5.1% between 2008 and 2010, with a larger increase (17.7%) for ED visits with a mental health disorder diagnostic code.

Additionally, although the Medicaid data allowed for the independent identification of people diagnosed with SMI, the data provided limited information on reasons for ED visits and length of stay. The current study used ICD-9-CM diagnosis codes as well as mental health and substance abuse procedure codes to identify "behavioral health-related" ED visits. Although some ED visits may have been misclassified using the study's multiple definitions for behavioral health-related visits, there is no reason to believe that this misclassification occurred at different rates in the pre- and post-waitlist period. ED length of stay in days was approximated based on dates of ED admission and discharge. Additional research should examine length of stay in the ED using other data sources that measure length of stay in greater detail.

Finally, the waitlist policy was announced statewide at the same time, without a control group of state hospitals that were unaffected by the policy. The current study defined the post-waitlist period based on date of policy announcement and date of implementation in an effort to take into account varied implementation dates across hospitals. In addition, the study used two control groups of geriatric and adolescent patients who were less frequently placed on state hospital waitlists

(according to waitlist data and conversations with state hospital administrators) to evaluate the policy's effects in a more rigorous manner as compared to pre/post comparisons without control groups. Here, the control groups provided information on what may have happened to ED utilization outcomes for non-geriatric adult Medicaid enrollees with SMI in the absence of the waitlist policies.

CONCLUSIONS

The current study found some regional variation in the effects of waitlists on ED utilization by Medicaid enrollees with SMI. These results demonstrate the importance of considering differences in local service areas before enacting broad, statewide mental health policies. However, the waitlist policy's effects in all regions were still small increases in ED utilization outcomes for the most part. Given the somewhat small effects of the waitlists on ED use by Medicaid enrollees with SMI, additional research is needed to determine whether these results extend to other populations, such as those who are uninsured or diagnosed with other mental health and substance abuse disorders.

Table 4.1: ICD-9-CM codes and procedure codes used to define behavioral health-related ED visits

Behavioral health-related ED visit definition	ICD-9-CM or procedure codes	Description
Presence of any mental health or substance abuse diagnoses listed anywhere (or listed first) in ED visit record	ICD-9-CM codes 290-294	Organic psychotic conditions, including dementias, drug- or alcohol-induced mental disorders, and transient or persistent mental disorders due to conditions classified elsewhere
	ICD-9-CM codes 295-299	Other psychoses, including schizophrenic disorders, episodic mood disorders, delusional disorders, other nonorganic psychoses, and pervasive developmental disorders
	ICD-9-CM codes 300-316	Neurotic disorders, personality disorders, and other non-psychotic mental disorders
	ICD-9-CM codes 648.4, V62.8, V66.3, V67.3, V70.1-V70.2, V71.0, V79.0, V79.1, V79.8-V79.9, E95	Other mental health and substance abuse disorders
Presence of mental health or substance abuse screening, medication management, or medication injection procedure code occurring on the same date as an ED visit	Procedure codes 80100-80102, 82055, 90801-90802, 96101-96103, 96150, G0396-G0397, H0001-H0003, H0031, H0048-H0049	Psychological testing and drug/alcohol screening
	Procedure codes 90862, H0020, H0033-H0034, H2010, M0064	Psychiatric medication management
	Procedure codes J1630-J1631, J2680, J2794, S0163	Psychiatric medication injections, including injection of haloperidol, haloperidol decanoate, fluphenazine decanoate, and risperidone

Table 4.2: ICD-9-CM codes used to classify medical, mental health, and substance abuse comorbidities

Description	ICD-9-CM codes
Medical comorbidities (Quan et al., 2005)[a]	
1. Congestive heart failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.4-425.9, 428.x
2. Cardiac arrhythmias	426.0, 426.13, 426.7, 426.9, 426.10, 426.12, 427.0-427.4, 427.6-427.9, 785.0, 996.01, 996.04, V45.0, V53.3
3. Valvular disease	093.2, 394.x-397.x, 424.x, 746.3-746.6, V42.2, V43.3
4. Pulmonary circulation disorders	415.0, 415.1, 416.x, 417.0,417.8, 417.9
5. Peripheral vascular disorders	093.0, 437.3, 440.x, 441.x, 443.1- 443.9, 447.1, 557.1, 557.9, V43.4
6. Hypertension, uncomplicated	401.x
7. Hypertension, complicated	402.x-405.x
8. Paralysis	334.1, 342.x, 343.x, 344.0-344.6, 344.9
9. Other neurological disorders	331.9, 332.0, 332.1, 333.4, 333.5, 333.92, 334.x-335.x, 336.2, 340.x, 341.x, 345.x, 348.1, 348.3, 780.3, 784.3
10. Chronic pulmonary disease	416.8, 416.9, 490.x -505.x, 506.4, 508.1, 508.8
11. Diabetes, uncomplicated	250.0-250.3
12. Diabetes, complicated	250.4-250.9
13. Hypothyroidism	240.9, 243.x, 244.x, 246.1, 246.8
14. Renal failure	403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 585.x, 586.x, 588.0, V42.0, V45.1, V56.x
15. Liver disease	070.22, 070.23, 070.32, 070.33, 070.44, 070.54, 070.6, 070.9, 456.0-456.2, 570.x, 571.x, 572.2-572.8, 573.3, 573.4, 573.8, 573.9, V42.7
16. Peptic ulcer disease, excluding bleeding	531.7, 531.9, 532.7, 532.9, 533.7, 533.9, 534.7, 534.9
17. AIDS/HIV	042.x-044.x
18. Lymphoma	200.x-202.x, 203.0,238.6
19.Metastatic cancer	196.x-199.x
20.Solid tumor without metastasis	140.x-172.x, 174.x-195.x
21. Rheumatoid arthritis/ collagen vascular diseases	446.x, 701.0, 710.0-710.4, 710.8, 710.9, 711.2, 714.x, 719.3, 720.x, 725.x, 728.5, 728.89, 729.30

(Continued)

Table 4.2: *(Continued)*

Description	ICD-9-CM codes
22. Coagulopathy	286.x, 287.1, 287.3-287.5
23. Obesity	278.0
24. Weight loss	260.x-263.x, 783.2, 799.4
25. Fluid and electrolyte disorders	253.6, 276.x
26. Blood loss anemia	280.0
27. Deficiency anemia	280.1-280.9, 281.x
Mental health comorbidities (non-SMI)	
1. Other psychoses	290.x, 293.x-294.x, 297.x, 298.2, 299.x
2. Mild depression	300.4, 311.x
3. Other episodic mood disorders	296.9
4. Stress and adjustment disorders	308.x-309.x
5. Personality disorders	301.x
6. Conduct disorders	312.x
7. Emotional disturbance disorders	313.x
8. Neurotic disorders	300.0-300.3, 300.5-300.9
9. Other mental health disorders	302.x, 306.x-307.x, 310.x, 314.x-316.x, 648.4, V62.8, V66.3, V67.3, V70.1-V70.2, V71.0, V79.0, V79.8-V79.9, E95
Substance abuse comorbidities	
1. Alcohol-related disorders	291.x, 303.x, 305.0, V79.1
2. Drug-related disorders	292.x, 304.x, 305.1-305.9, 648.3

Notes:
[a] The medical comorbidities follow the Enhanced Elixhauser coding algorithm, but exclude the algorithm's last four comorbidities related to alcohol abuse, drug abuse, psychoses, and depression. These comorbidities are captured in the substance abuse and mental health comorbidity measures, which are grouped into clinically meaningful groups.

Table 4.3: Characteristics of person-month observations of Medicaid enrollees with SMI, by state psychiatric hospital region

Variable	Broughton Western Region (n=2,631,564)	Central Regional North Central Region (n=1,504,841)	Cherry Eastern Region (n=1,873,568)	Dix South Central Region (n=1,449,874)
Categorical variables, n (%)[a]				
Sex				
Male	786,087 (29.9)	467,018 (31.0)	588,805 (31.4)	441,207 (30.4)
Female	1,845,477 (70.1)	1,037,823 (69.0)	1,284,763 (68.6)	1,008,667 (69.6)
Race				
White	1,967,161 (74.8)	710,552 (47.2)	878,150 (46.9)	725,237 (50.0)
Black	562,282 (21.4)	734,511 (48.8)	898,643 (48.0)	595,849 (41.1)
Other	21,119 (0.8)	16,722 (1.1)	47,858 (2.6)	80,578 (5.6)
Unknown	81,002 (3.1)	43,056 (2.9)	48,917 (2.6)	48,210 (3.3)
Ethnicity				
Hispanic	33,815 (1.3)	16,825 (1.1)	20,972 (1.1)	29,402 (2.0)
Non-Hispanic	2,209,362 (84.0)	1,252,934 (83.3)	1,556,820 (83.1)	1,208,568 (83.4)
Unknown	388,387 (14.8)	235,082 (15.6)	295,776 (15.8)	211,904 (14.6)
Insurance status during month				
Medicaid only	1,803,437 (68.5)	1,003,864 (66.7)	1,258,649 (67.2)	985,310 (68.0)
Fully dual eligible for Medicaid / Medicare	828,127 (31.5)	500,977 (33.3)	614,919 (32.8)	464,564 (32.0)
SMI diagnosis (ever)				
Schizophrenia or other nonorganic psychoses	928,910 (35.3)	596,640 (39.7)	793,323 (42.3)	578,658 (39.9)
Bipolar disorder	1,518,540 (57.7)	786,237 (52.3)	869,388 (46.4)	758,124 (52.3)
Major depression	1,798,505 (68.3)	993,481 (66.0)	1,256,625 (67.1)	946,821 (65.3)
Continuous variables, mean (standard deviation)				
Age at beginning of month	41.2 (13.5)	40.9 (13.5)	41.7 (13.7)	41.0 (13.4)
Number of comorbid conditions (ever)				
Medical comorbidity	4.1 (3.5)	3.8 (3.4)	4.0 (3.5)	4.2 (3.6)
Psychiatric comorbidity (non-SMI)	2.6 (1.5)	2.3 (1.6)	2.2 (1.5)	2.2 (1.5)
Substance abuse comorbidity	0.8 (0.7)	0.8 (0.7)	0.7 (0.7)	0.8 (0.7)

Notes:

[a] All categorical variables are mutually exclusive (sum to 100% within columns, by subgroups), with the exception of SMI diagnosis.

Table 4.4: Emergency department (ED) utilization pre- and post-waitlist by state psychiatric hospital region[a]

ED utilization measure	Broughton Western Region			Central Regional North Central Region			Cherry Eastern Region			Dix South Central Region		
	Pre	Post	Unadjusted difference (p-value)[b]	Pre	Post	Unadjusted difference (p-value)[b]	Pre	Post	Unadjusted difference (p-value)[b]	Pre	Post	Unadjusted difference (p-value)[b]
Percent of person-month observations with any ED visits during month												
Treatment group of adults aged 18-64												
All ED visits	14.74	14.87	0.12 (p=0.005)	12.66	12.63	-0.03 (p=0.6)	12.34	12.94	0.60 (p<0.001)	12.54	12.39	-0.15 (p=0.007)
Behavioral health-related ED visits (any diagnoses)	6.94	7.37	0.43 (p<0.001)	4.95	5.30	0.36 (p<0.001)	4.24	5.36	1.12 (p<0.001)	4.24	5.41	1.17 (p<0.001)
Behavioral health-related ED visits (first diagnosis)	3.25	3.57	0.32 (p<0.001)	2.65	2.85	0.20 (p<0.001)	2.46	2.88	0.42 (p<0.001)	2.25	2.55	0.30 (p<0.001)
Behavioral health-related ED visits (procedure codes)	1.59	1.89	0.31 (p<0.001)	1.55	1.68	0.13 (p<0.001)	1.50	1.99	0.48 (p<0.001)	1.48	1.58	0.10 (p<0.001)
Control group of adults aged 65-74												
All ED visits	8.67	8.65	-0.02 (p=0.93)	7.38	7.41	0.03 (p=0.9)	7.91	9.24	1.34 (p<0.001)	9.31	8.42	-0.89 (p=0.001)
Behavioral health-related ED visits (any diagnoses)	3.53	3.87	0.34 (p=0.004)	2.91	3.13	0.21 (p=0.1)	2.77	3.81	1.03 (p<0.001)	2.99	3.35	0.36 (p=0.02)
Behavioral health-related ED visits (first diagnosis)	1.66	1.90	0.24 (p=0.004)	1.74	1.86	0.12 (p=0.3)	1.67	2.12	0.45 (p<0.001)	1.68	1.81	0.13 (p=0.3)
Behavioral health-related ED visits (procedure codes)	0.37	0.58	0.21 (p<0.001)	0.33	0.49	0.16 (p=0.004)	0.48	0.74	0.27 (p<0.001)	0.48	0.58	0.10 (p=0.1)

(Continued)

Table 4.4: *(Continued)*

ED utilization measure	Broughton Western Region			Central Regional North Central Region			Cherry Eastern Region			Dix South Central Region		
	Pre	Post	Unadjusted difference (p-value)[b]	Pre	Post	Unadjusted difference (p-value)[b]	Pre	Post	Unadjusted difference (p-value)[b]	Pre	Post	Unadjusted difference (p-value)[b]
Mean number of ED visits in person-month observation												
Treatment group of adults aged 18-64												
All ED visits	0.21	0.22	0.01 (p<0.001)	0.18	0.18	0.00 (p=0.01)	0.17	0.18	0.01 (p<0.001)	0.18	0.18	0.00 (p=0.3)
Behavioral health-related ED visits (any diagnoses)	0.09	0.09	0.01 (p<0.001)	0.06	0.07	0.01 (p<0.001)	0.05	0.07	0.01 (p<0.001)	0.05	0.07	0.02 (p<0.001)
Behavioral health-related ED visits (first diagnosis)	0.04	0.04	0.00 (p<0.001)	0.03	0.04	0.00 (p<0.001)	0.03	0.04	0.01 (p<0.001)	0.03	0.03	0.00 (p<0.001)
Behavioral health-related ED visits (procedure codes)	0.02	0.02	0.00 (p<0.001)	0.02	0.02	0.00 (p<0.001)	0.02	0.02	0.01 (p<0.001)	0.02	0.02	0.00 (p<0.001)
Control group of adults aged 65-74												
All ED visits	0.12	0.12	0.00 (p=0.3)	0.11	0.10	0.00 (p=0.3)	0.11	0.13	0.02 (p<0.001)	0.14	0.12	-0.01 (p=0.002)
Behavioral health-related ED visits (any diagnoses)	0.04	0.05	0.00 (p=0.03)	0.04	0.04	0.00 (p=0.05)	0.03	0.05	0.01 (p<0.001)	0.04	0.04	0.00 (p=0.05)
Behavioral health-related ED visits (first diagnosis)	0.02	0.02	0.00 (p=0.01)	0.02	0.02	0.00 (p=0.09)	0.02	0.03	0.01 (p<0.001)	0.02	0.02	0.00 (p=0.3)
Behavioral health-related ED visits (procedure codes)	0.00	0.01	0.00 (p<0.001)	0.00	0.01	0.00 (p=0.003)	0.01	0.01	0.00 (p<0.001)	0.01	0.01	0.00 (p=0.09)

(Continued)

Table 4.4: *(Continued)*

ED utilization measure	Broughton Western Region			Central Regional North Central Region			Cherry Eastern Region			Dix South Central Region		
	Pre	Post	Unadjusted difference (p-value)[b]	Pre	Post	Unadjusted difference (p-value)[b]	Pre	Post	Unadjusted difference (p-value)[b]	Pre	Post	Unadjusted difference (p-value)[b]
Mean ED visit length of stay, in days												
Treatment group of adults aged 18-64												
All ED visits	0.14	0.13	-0.01 (p=0.2)	0.17	0.15	-0.03 (p=0.002)	0.17	0.15	-0.02 (p=0.09)	0.17	0.14	-0.03 (p=0.004)
Behavioral health-related ED visits (any diagnoses)	0.22	0.18	-0.04 (p<0.001)	0.34	0.26	-0.09 (p<0.001)	0.33	0.27	-0.07 (p<0.001)	0.33	0.19	-0.14 (p<0.001)
Behavioral health-related ED visits (first diagnosis)	0.34	0.27	-0.07 (p<0.001)	0.45	0.34	-0.11 (p<0.001)	0.42	0.38	-0.04 (p=0.2)	0.39	0.26	-0.14 (p<0.001)
Behavioral health-related ED visits (procedure codes)	0.04	0.05	0.01 (p=0.2)	0.11	0.06	-0.04 (p=0.007)	0.07	0.06	-0.02 (p=0.1)	0.06	0.04	-0.02 (p=0.009)
Control group of adults aged 65-74												
All ED visits	0.54	0.38	-0.16 (p<0.001)	0.66	0.59	-0.07 (p=0.3)	0.57	0.66	0.09 (p=0.1)	0.56	0.53	-0.03 (p=0.6)
Behavioral health-related ED visits (any diagnoses)	1.03	0.65	-0.38 (p<0.001)	1.48	0.96	-0.53 (p<0.001)	1.10	1.15	0.04 (p=0.7)	1.33	1.04	-0.29 (p=0.07)
Behavioral health-related ED visits (first diagnosis)	1.23	0.76	-0.47 (p<0.001)	1.81	1.19	-0.62 (p=0.01)	0.25	0.40	0.15 (p=0.5)	1.47	1.31	-0.16 (p=0.5)
Behavioral health-related ED visits (procedure codes)	0.21	0.02	-0.19 (p=0.3)	0.37	0.09	-0.28 (p=0.2)	0.13	0.20	0.06 (p=0.6)	0.27	0.41	0.13 (p=0.6)

Notes:

[a] Post-waitlist period was defined based on date of waitlist implementation. Results defining the post-waitlist period based on date of policy announcement were similar and are not reported here.
[b] P-values were determined based on t-tests with unequal variances.

Table 4.5: Average marginal effects of the waitlist policy on probability of having any ED visits in month by Medicaid enrollees with SMI, by state hospital region

Analysis scenario	Post-waitlist average marginal effect (standard error)[a]							
	Any ED visits in month, %				Any behavioral health-related ED visits in month, %[b]			
	Broughton Western Region (n=2,631,564)	Central Regional North Central Region (n=1,504,841)	Cherry Eastern Region (n=1,873,568)	Dix South Central Region (n=1,449,874)	Broughton Western Region (n=2,631,564)	Central Regional North Central Region (n=1,504,841)	Cherry Eastern Region (n=1,873,568)	Dix South Central Region (n=1,449,874)
Main Analysis: Defining post-waitlist period based on date of waitlist implementation	0.632 (0.00)	0.743 (0.00)	0.546 (0.01)	0.780 (0.01)	-0.152 (0.00)	0.370 (0.00)	0.456 (0.00)	0.870* (0.00)
Main Analysis: Defining post-waitlist period based on date of policy announcement	0.618 (0.00)	1.213* (0.00)	-0.220 (0.00)	0.718 (0.00)	-0.151 (0.00)	0.377 (0.00)	0.156 (0.00)	0.711* (0.00)
Sensitivity Analysis 1: Defining "behavioral health-related" ED visits based on first-listed diagnoses	--	--	--	--	-0.237 (0.00)	0.577** (0.00)	0.210 (0.00)	0.589* (0.00)
Sensitivity Analysis2: Defining "behavioral health-related" ED visits based on procedure codes	--	--	--	--	-0.255** (0.00)	0.102 (0.00)	0.326 (0.00)	0.051 (0.00)
Sensitivity Analysis 3: Including statewide psychiatric beds in state hospitals per 100,000 population as control variable	0.631 (0.00)	0.740 (0.00)	0.534 (0.01)	0.773 (0.01)	-0.154 (0.00)	0.366 (0.00)	0.452 (0.00)	0.871* (0.00)
Sensitivity Analysis 4: Including regional psychiatric beds in state hospitals per 100,000 population as control variable	0.632 (0.00)	0.753 (0.00)	0.548 (0.01)	0.778 (0.01)	-0.152 (0.00)	0.374 (0.00)	0.458 (0.00)	0.869* (0.00)
Sensitivity Analysis 5: Excluding people with major depression from sample of Medicaid enrollees with SMI	0.714 (0.00)	1.132* (0.01)	0.494 (0.01)	1.234* (0.01)	-0.252 (0.00)	0.414 (0.00)	0.747 (0.01)	1.209** (0.00)
Sensitivity Analysis 6: Using adolescents aged 13-17 years as control group	-0.375* (0.00)	0.484* (0.00)	0.993** (0.00)	0.500* (0.00)	-0.728*** (0.00)	0.109 (0.00)	0.329 (0.00)	0.190 (0.00)
Sensitivity Analysis 7: Pre/post comparison, excluding control group	-0.433*** (0.00)	-1.133*** (0.00)	-0.225 (0.00)	0.372** (0.00)	-0.626*** (0.00)	-0.405*** (0.00)	-0.544*** (0.00)	-0.007 (0.00)

* p<0.05

** p<0.01

*** p<0.001

Notes:

[a] Average marginal effects estimated using linear probability models; standard errors estimated using 100 bootstrap replications. In all models, other independent variables controlled for time trends (linear time trend and calendar month of observation), person-level characteristics (enrollee age at beginning of month; sex; race; ethnicity; dual eligible insurance status; SMI diagnoses; number of comorbid medical, mental health, and substance abuse conditions), and county-level characteristics (unemployment rate, number of licensed psychiatrists per 100,000 population, and number of licensed adult psychiatric beds in general hospital psychiatric units/private psychiatric hospitals per 100,000 population) unless otherwise noted.

[b] Behavioral health-related ED visits were defined based on the presence of a mental health or substance abuse diagnosis listed anywhere in the ED visit record, with the exception of sensitivity analyses 1 and 2.

Table 4.6: Average marginal effects of the waitlist policy on number of ED visits in month by Medicaid enrollees with SMI, by state hospital region

Analysis scenario	Post-waitlist average marginal effect (standard error)[a]							
	Number of ED visits in month				Number of behavioral health-related ED visits in month[b]			
	Broughton Western Region (n=2,631,564)	Central Regional North Central Region (n=1,504,841)	Cherry Eastern Region (n=1,873,568)	Dix South Central Region (n=1,449,874)	Broughton Western Region (n=2,631,564)	Central Regional North Central Region (n=1,504,841)	Cherry Eastern Region (n=1,873,568)	Dix South Central Region (n=1,449,874)
Main Analysis: Defining post-waitlist period based on date of waitlist implementation	0.016* (0.01)	0.007 (0.00)	0.010 (0.01)	0.025* (0.01)	-0.002 (0.00)	-0.002 (0.00)	0.004 (0.00)	0.010** (0.00)
Main Analysis: Defining post-waitlist period based on date of policy announcement	0.016** (0.01)	0.015** (0.01)	0.001 (0.01)	0.020* (0.01)	-0.003 (0.00)	-0.002 (0.00)	0.003 (0.00)	0.009* (0.00)
Sensitivity Analysis 1: Defining "behavioral health-related" ED visits based on first-listed diagnoses	--	--	--	--	-0.004* (0.00)	0.001 (0.00)	0.003 (0.00)	0.007** (0.00)
Sensitivity Analysis2: Defining "behavioral health-related" ED visits based on procedure codes	--	--	--	--	-0.003** (0.00)	0.000 (0.00)	0.005 (0.00)	0.002 (0.00)
Sensitivity Analysis 3: Including statewide psychiatric beds in state hospitals per 100,000 population as control variable	0.019** (0.01)	0.010* (0.00)	0.015 (0.01)	0.027* (0.01)	0.003 (0.00)	0.001 (0.00)	0.006 (0.00)	0.010** (0.00)
Sensitivity Analysis 4: Including regional psychiatric beds in state hospitals per 100,000 population as control variable	0.016* (0.01)	0.008 (0.01)	0.010 (0.01)	0.024* (0.01)	-0.003 (0.00)	-0.002 (0.00)	0.004 (0.00)	0.009* (0.00)
Sensitivity Analysis 5: Excluding people with major depression from sample of Medicaid enrollees with SMI	0.021** (0.01)	0.011 (0.01)	0.010 (0.01)	0.037*** (0.01)	-0.004 (0.00)	-0.002 (0.00)	0.006 (0.00)	0.013** (0.00)
Sensitivity Analysis 6: Using adolescents aged 13-17 years as control group	-0.007** (0.00)	-0.003 (0.00)	0.001 (0.00)	0.012** (0.00)	-0.011*** (0.00)	-0.002 (0.00)	-0.001 (0.00)	0.001 (0.00)
Sensitivity Analysis 6: Pre/post comparison, excluding control group	-0.008*** (0.00)	-0.017*** (0.00)	-0.006* (0.00)	0.009** (0.00)	-0.011*** (0.00)	-0.006*** (0.00)	-0.003** (0.00)	0.001 (0.00)

* p<0.05

** p<0.01

*** p<0.001

Notes:

[a] Average marginal effects estimated using hurdle models; standard errors estimated using 100 bootstrap replications. In all models, other independent variables controlled for time trends (linear time trend and calendar month of observation), person-level characteristics (enrollee age at beginning of month; sex; race; ethnicity; dual eligible insurance status; SMI diagnoses; number of comorbid medical, mental health, and substance abuse conditions), and county-level characteristics (unemployment rate, number of licensed psychiatrists per 100,000 population, and number of licensed adult psychiatric beds in general hospital psychiatric units/private psychiatric hospitals per 100,000 population) unless otherwise noted.

[b] Behavioral health-related ED visits were defined based on the presence of a mental health or substance abuse diagnosis listed anywhere in the ED visit record, with the exception of sensitivity analyses 1 and 2.

Table 4.7: Average marginal effects of the waitlist policy on ED length of stay for Medicaid enrollees with SMI, by state hospital region

Analysis scenario	Post-waitlist average marginal effect (standard error)[a]							
	ED visit length of stay, days				Behavioral health-related ED visit length of stay, days[b]			
	Broughton Western Region (n=552,837)	Central Regional North Central Region (n=270,801)	Cherry Eastern Region (n=327,211)	Dix South Central Region (n=255,241)	Broughton Western Region (n=235,658)	Central Regional North Central Region (n=95,029)	Cherry Eastern Region (n=107,153)	Dix South Central Region (n=84,338)
Main Analysis: Defining post-waitlist period based on date of waitlist implementation	0.222** (0.05)	0.082 (0.06)	0.072 (0.07)	0.088 (0.05)	0.366** (0.11)	0.340* (0.14)	0.118 (0.15)	0.284 (0.16)
Main Analysis: Defining post-waitlist period based on date of policy announcement	0.219*** (0.05)	0.111 (0.07)	0.260** (0.10)	0.189** (0.06)	0.364*** (0.10)	0.390* (0.17)	0.411 (0.23)	0.563* (0.23)
Sensitivity Analysis 1: Defining "behavioral health-related" ED visits based on first-listed diagnoses	--	--	--	--	0.485* (0.21)	0.381 (0.20)	0.041 (0.24)	0.033 (0.28)
Sensitivity Analysis2: Defining "behavioral health-related" ED visits based on procedure codes	--	--	--	--	-0.115 (2.19)	0.041 (0.26)	-0.229 (1.56)	-0.131 (0.14)
Sensitivity Analysis 3: Including statewide psychiatric beds in state hospitals per 100,000 population as control variable	0.133** (0.04)	0.029 (0.06)	0.033 (0.09)	0.062 (0.05)	0.158* (0.08)	0.266* (0.13)	-0.026 (0.22)	0.208 (0.16)
Sensitivity Analysis 4: Including regional psychiatric beds in state hospitals per 100,000 population as control variable	0.211*** (0.05)	0.143 (0.10)	0.083 (0.08)	0.078 (0.06)	0.355** (0.10)	0.546* (0.23)	0.147 (0.18)	0.272 (0.16)
Sensitivity Analysis 5: Excluding people with major depression from sample of Medicaid enrollees with SMI	0.210** (0.06)	0.176** (0.06)	0.125* (0.06)	0.072 (0.07)	0.404** (0.14)	0.469** (0.16)	0.136 (0.18)	0.244 (0.20)
Sensitivity Analysis 6: Using adolescents aged 13-17 years as control group	-0.001 (0.02)	-0.075* (0.03)	-0.060 (0.04)	-0.050* (0.02)	0.002 (0.02)	-0.128 (0.08)	-0.317 (0.32)	-0.113* (0.05)
Sensitivity Analysis 7: Pre/post comparison, excluding control group	-0.013 (0.01)	-0.051** (0.01)	-0.049** (0.02)	-0.039 (0.02)	-0.022* (0.01)	-0.093** (0.03)	-0.092** (0.03)	-0.108** (0.03)

* p<0.05

** p<0.01

*** p<0.001

Notes:

[a] Average marginal effects estimated using hurdle models; standard errors estimated using 100 bootstrap replications. In all models, other independent variables controlled for time trends (linear time trend and calendar month of observation), person-level characteristics (enrollee age at beginning of month; sex; race; ethnicity; dual eligible insurance status; SMI diagnoses; number of comorbid medical, mental health, and substance abuse conditions), and county-level characteristics (unemployment rate, number of licensed psychiatrists per 100,000 population, and number of licensed adult psychiatric beds in general hospital psychiatric units/private psychiatric hospitals per 100,000 population) unless otherwise noted.

[b] Behavioral health-related ED visits were defined based on the presence of a mental health or substance abuse diagnosis listed anywhere in the ED visit record, with the exception of sensitivity analyses 1 and 2.

Table 4.8: Predicted ED utilization outcomes pre- and post-waitlist, by state hospital region[a]

	Predicted value (95% confidence interval)							
	Broughton Western Region		Central Regional North Central Region		Cherry Eastern Region		Dix South Central Region	
	Pre-waitlist	Post-waitlist	Pre-waitlist	Post-waitlist	Pre-waitlist	Post-waitlist	Pre-waitlist	Post-waitlist
Any ED visits, %								
All ED visits								
Treatment group of adults aged 18-64	15.084 (14.865-15.302)	14.667 (14.393-14.941)	12.046 (11.785-12.307)	10.931 (10.533-11.330)	12.276 (12.092-12.460)	12.073 (11.621-12.524)	12.842 (12.624-13.059)	13.202 (12.766-13.638)
Control group of adults aged 65-74	19.133 (18.346-19.921)	18.088 (17.357-18.819)	14.674 (13.780-15.567)	12.782 (11.688-13.877)	14.800 (14.186-15.413)	14.078 (12.631-15.525)	16.059 (15.142-16.977)	15.671 (14.398-16.944)
Behavioral health-related ED visits								
Treatment group of adults aged 18-64	7.574 (7.424-7.724)	6.943 (6.755-7.130)	5.003 (4.856-5.150)	4.592 (4.363-4.821)	4.227 (4.122-4.332)	3.695 (3.414-3.975)	4.549 (4.434-4.664)	4.551 (4.313-4.789)
Control group of adults aged 65-74	8.687 (8.225-9.148)	8.207 (7.750-8.663)	5.473 (4.979-5.966)	4.670 (4.028-5.312)	5.247 (4.894-5.600)	4.313 (3.417-5.208)	5.598 (5.160-6.037)	4.712 (3.937-5.487)
Number of ED visits								
All ED visits								
Treatment group of adults aged 18-64	0.218 (0.214-0.223)	0.211 (0.206-0.216)	0.172 (0.168-0.176)	0.156 (0.150-0.161)	0.174 (0.170-0.177)	0.168 (0.160-0.175)	0.186 (0.181-0.190)	0.195 (0.185-0.204)
Control group of adults aged 65-74	0.308 (0.283-0.332)	0.260 (0.241-0.279)	0.220 (0.196-0.243)	0.169 (0.151-0.188)	0.220 (0.204-0.235)	0.192 (0.165-0.218)	0.268 (0.239-0.297)	0.242 (0.203-0.280)
Behavioral health-related ED visits								
Treatment group of adults aged 18-64	0.099 (0.096-0.101)	0.088 (0.086-0.091)	0.062 (0.060-0.064)	0.056 (0.054-0.059)	0.053 (0.051-0.054)	0.050 (0.048-0.052)	0.057 (0.055-0.059)	0.058 (0.055-0.061)
Control group of adults aged 65-74	0.114 (0.100-0.127)	0.097 (0.087-0.106)	0.062 (0.052-0.071)	0.053 (0.045-0.060)	0.066 (0.058-0.075)	0.054 (0.045-0.063)	0.073 (0.062-0.083)	0.056 (0.045-0.067)
ED visit length of stay, days								
All ED visits								
Treatment group of adults aged 18-64	0.114 (0.091-0.136)	0.100 (0.085-0.114)	0.157 (0.116-0.198)	0.103 (0.089-0.118)	0.165 (0.142-0.188)	0.113 (0.080-0.146)	0.168 (0.137-0.200)	0.125 (0.090-0.160)
Control group of adults aged 65-74	0.126 (0.088-0.165)	0.061 (0.045-0.077)	0.109 (0.073-0.146)	0.079 (0.049-0.109)	0.122 (0.091-0.152)	0.085 (0.052-0.118)	0.127 (0.089-0.166)	0.091 (0.061-0.121)
Behavioral health-related ED visits								
Treatment group of adults aged 18-64	0.150 (0.136-0.163)	0.125 (0.109-0.142)	0.268 (0.182-0.354)	0.169 (0.146-0.192)	0.291 (0.244-0.339)	0.192 (0.142-0.242)	0.294 (0.215-0.373)	0.177 (0.141-0.212)
Control group of adults aged 65-74	0.180 (0.122-0.238)	0.089 (0.065-0.112)	0.221 (0.137-0.304)	0.104 (0.053-0.155)	0.246 (0.174-0.319)	0.182 (0.109-0.254)	0.270 (0.165-0.375)	0.160 (0.099-0.221)

Notes:
[a] Predictions are based on results from main analysis models, defining the post-waitlist period based on date of waitlist implementation. Standard errors were estimated using the delta method, with 95% confidence intervals reported in parentheses.
[b] Behavioral health-related ED visits were defined based on the presence of a mental health or substance abuse diagnosis listed anywhere in the ED visit record.

Figure 4.1: Map of North Carolina state psychiatric hospital catchment areas

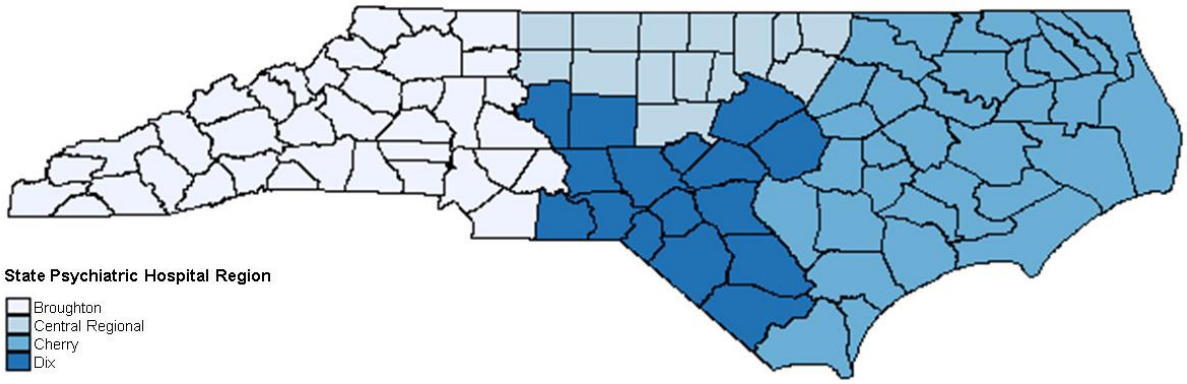
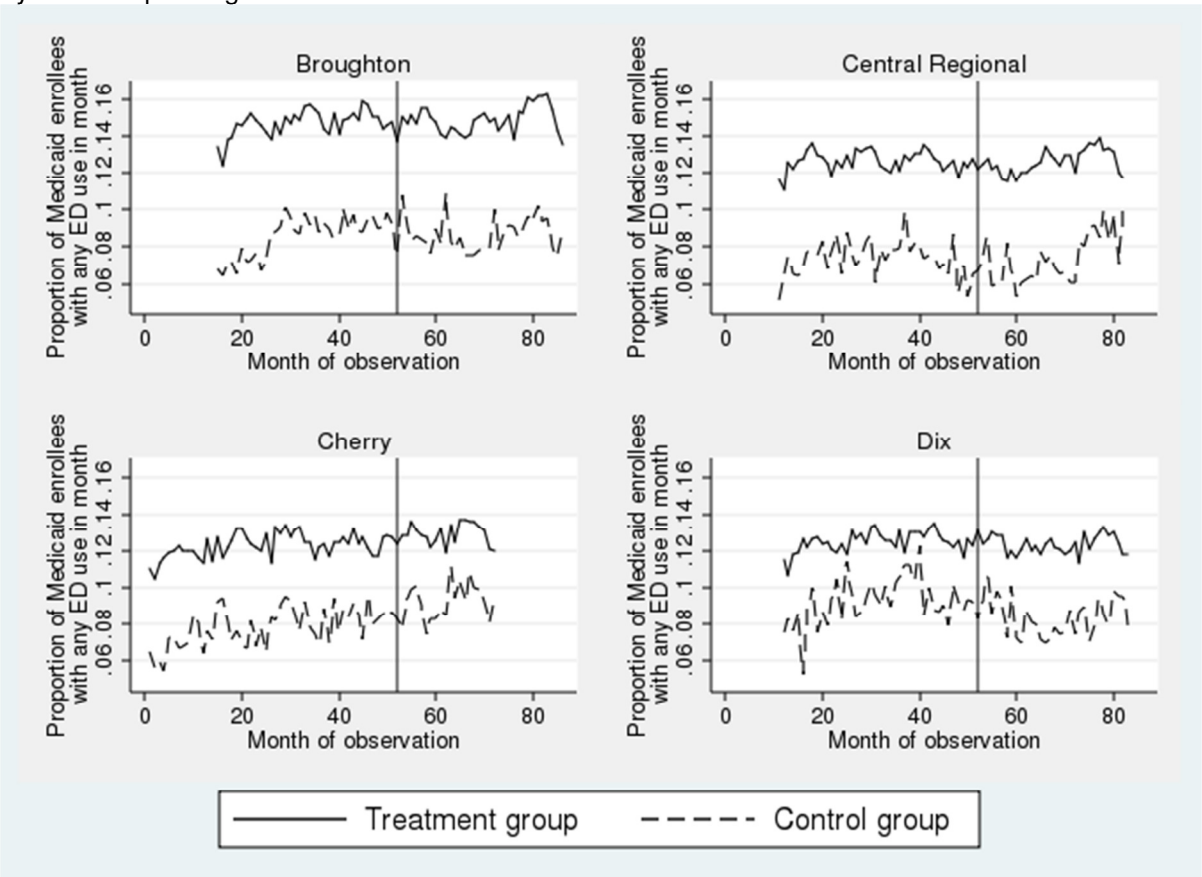
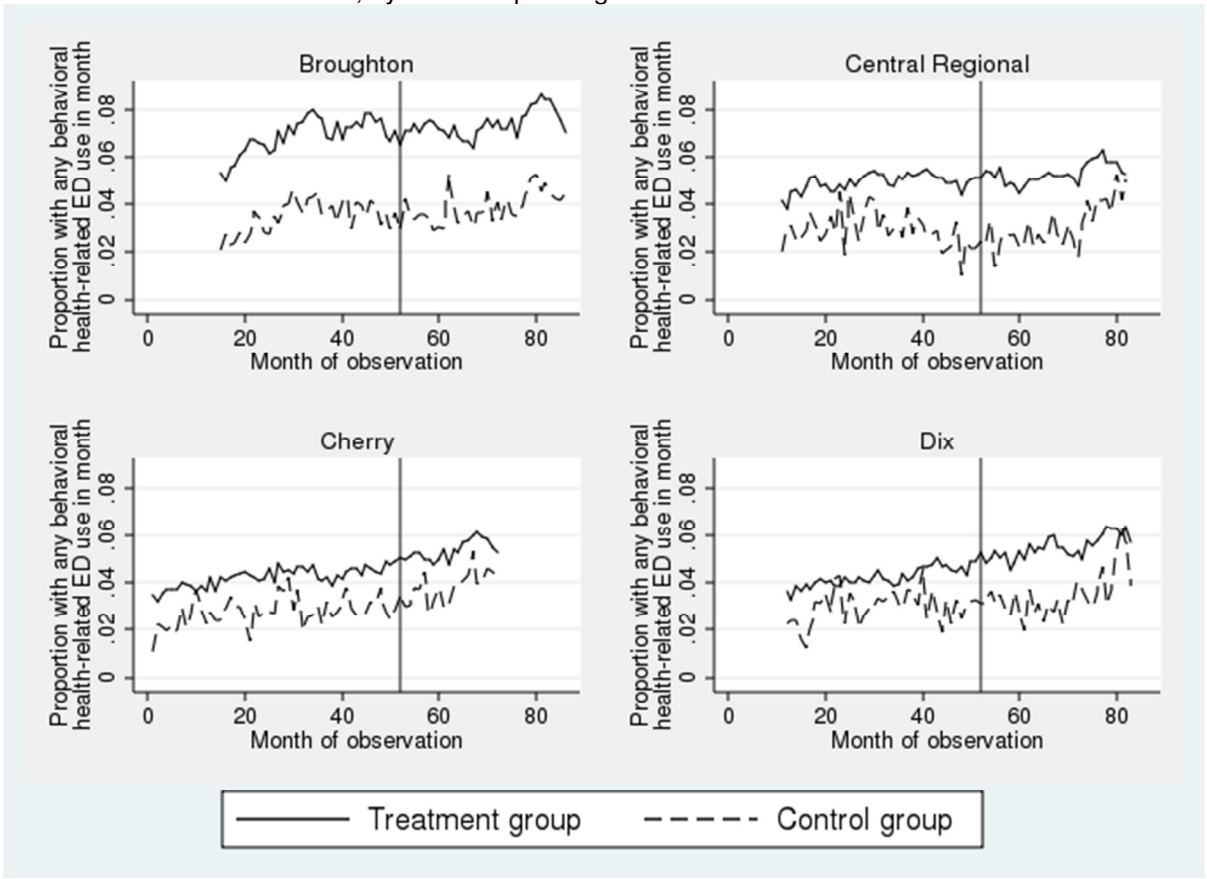


Figure 4.2: Time series plots of the proportion of Medicaid enrollees with any ED use in each month, by state hospital region



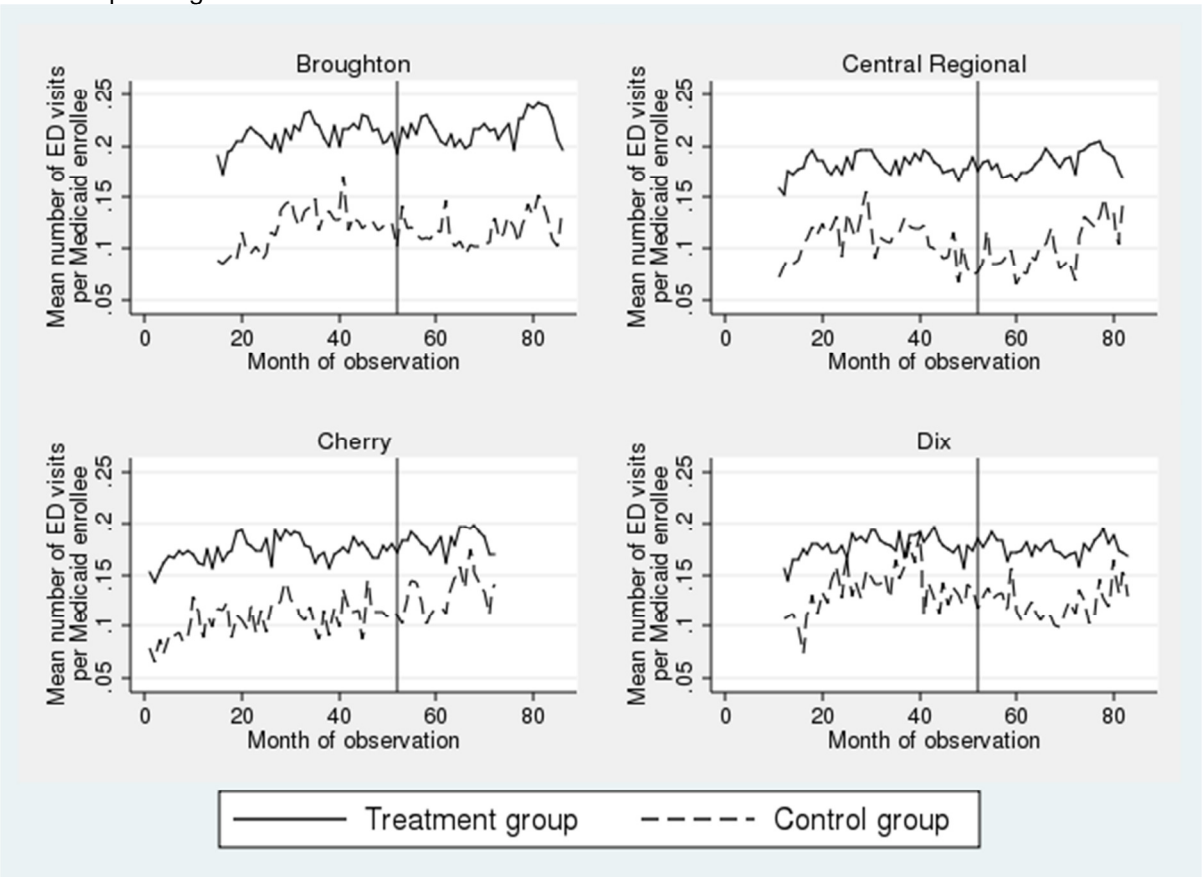
Note: Vertical line at month 52 indicates month of waitlist policy implementation. Time series plots defining the post-waitlist period based on date of policy announcement were similar and are not shown here.

Figure 4.3: Time series plots of the proportion of Medicaid enrollees with any behavioral health-related ED use in each month, by state hospital region



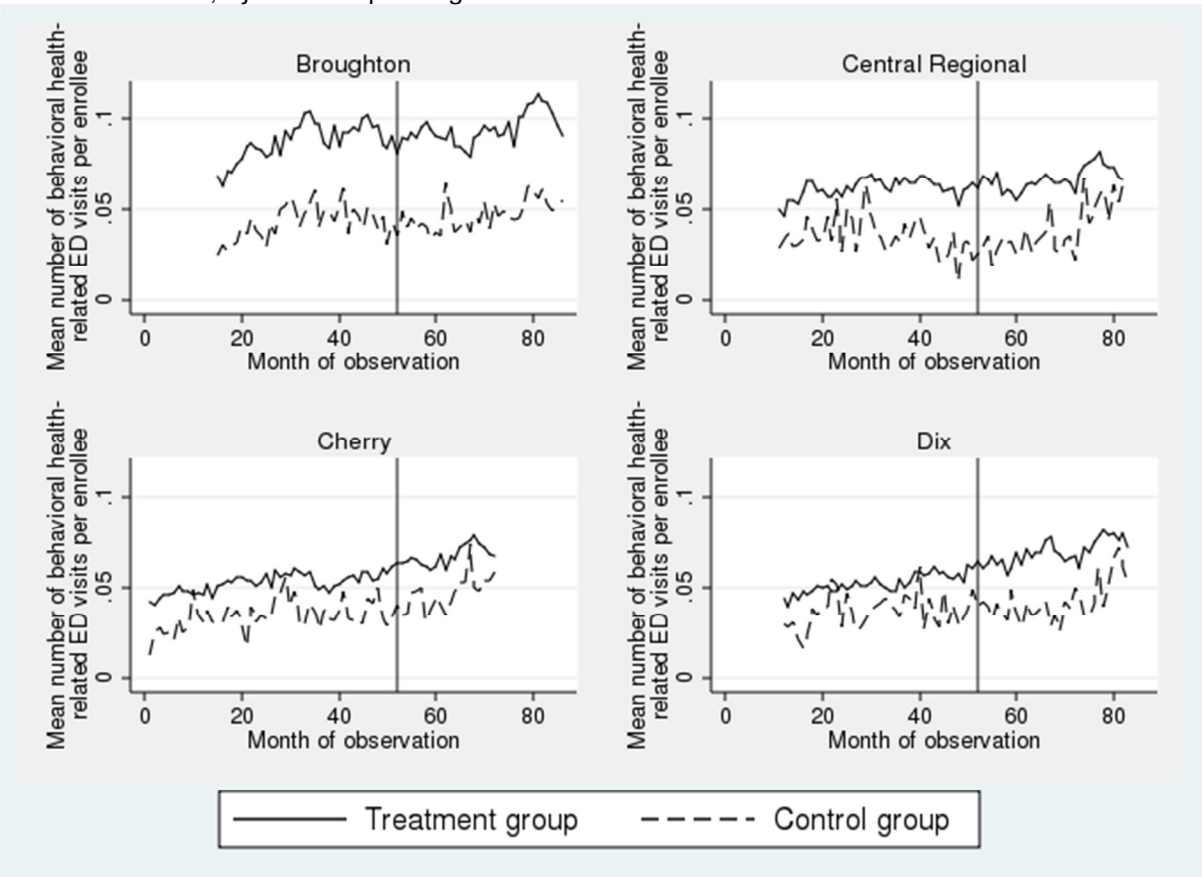
Note: Vertical line at month 52 indicates month of waitlist policy implementation. Time series plots defining the post-waitlist period based on date of policy announcement were similar and are not shown here.

Figure 4.4: Time series plots of the mean number of monthly ED visits per Medicaid enrollee, by state hospital region



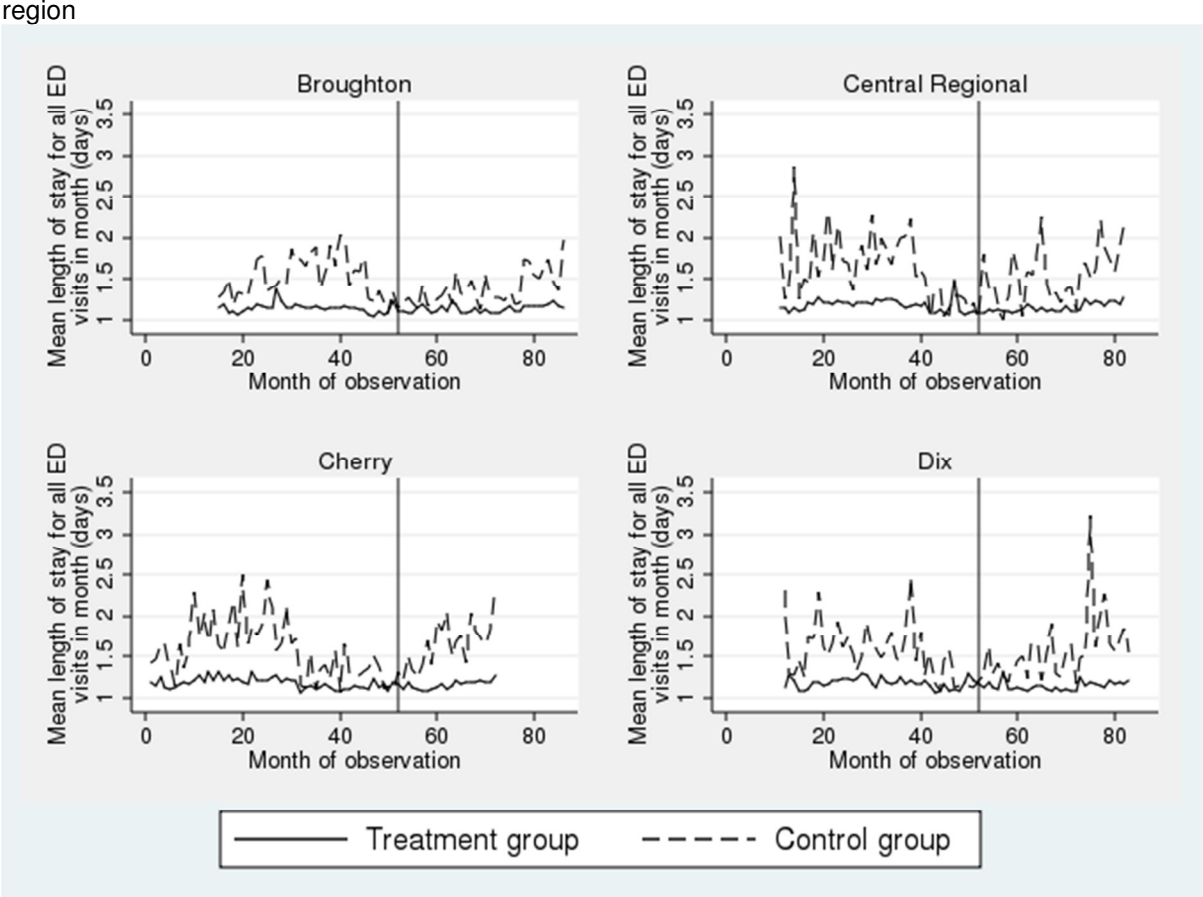
Note: Vertical line at month 52 indicates month of waitlist policy implementation. Time series plots defining the post-waitlist period based on date of policy announcement were similar and are not shown here.

Figure 4.5: Time series plots of the mean number of monthly behavioral health-related ED visits per Medicaid enrollee, by state hospital region



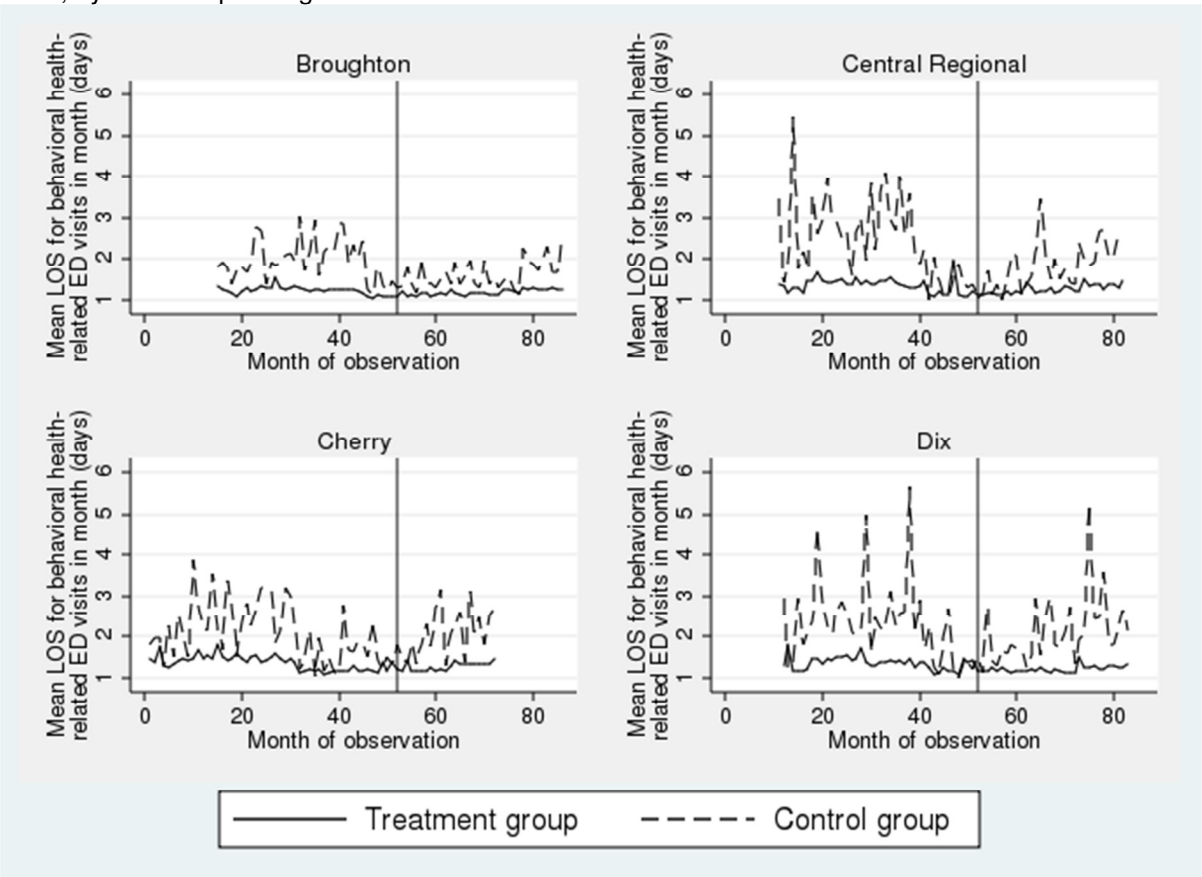
Note: Vertical line at month 52 indicates month of waitlist policy implementation. Time series plots defining the post-waitlist period based on date of policy announcement were similar and are not shown here.

Figure 4.6: Time series plots of the monthly mean length of stay for all ED visits, by state hospital region



Note: Vertical line at month 52 indicates month of waitlist policy implementation. Time series plots defining the post-waitlist period based on date of policy announcement were similar and are not shown here.

Figure 4.7: Time series plots of the monthly mean length of stay for behavioral health-related ED visits, by state hospital region



Note: Vertical line at month 52 indicates month of waitlist policy implementation. Time series plots defining the post-waitlist period based on date of policy announcement were similar and are not shown here.

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CHAPTER 5

CONCLUSIONS

Summary of findings

This dissertation offered a statewide assessment of the effects of a state psychiatric hospital waitlist policy, taking both an inward look at the effects of waitlists on the number and types of patients admitted to state hospitals and an outward look at the effects of waitlists on general hospital emergency department (ED) use. Specifically, the first study used North Carolina state hospital utilization data from 2004-2010 in a pre/post comparison to examine whether waitlists were associated with changes in the monthly number of admissions overall, as well as the number and case mix of admissions by people with severe mental illness (SMI). In unadjusted results, state hospitals experienced a 46.4% reduction in mean number of monthly admissions post-waitlist (281.0 admissions pre-waitlist vs. 150.6 admissions post-waitlist, $p<0.001$). These reductions occurred across all patient subgroups analyzed. For example, the mean number of monthly admissions by people with SMI decreased by 42.0% post-waitlist (165.8 admissions pre-waitlist vs. 96.1 post-waitlist, $p<0.001$). With regards to case mix of admissions, the percent of monthly admissions by people with SMI experienced a relative 17.1% increase post-waitlist (59.7% pre-waitlist vs. 69.9% post-waitlist, $p<0.001$). However, these unadjusted results were only partially consistent with results from regression analyses. Overall, waitlists were associated with an average 53.1 fewer total monthly admissions in all months post-waitlist ($p<0.001$) and an incremental 1.6 fewer total admissions in each additional month post-waitlist ($p=0.01$). Specific to admissions by people with SMI, waitlists were associated with an average 31.8 fewer monthly admissions across all months post-waitlist ($p<0.001$) and an incremental 1.4 fewer admissions in each additional month post-waitlist ($p<0.001$). Contrary to the study's hypotheses, waitlists were *not* associated with a statistically significant increase in the percent of monthly admissions by people with SMI. However, given the post-waitlist

decrease in number of admissions by people overall and by people with SMI, additional research was still needed to determine whether people with SMI were increasingly presenting to general hospital EDs to receive care.

The second and third studies used North Carolina Medicaid data from 2004-2009, employing a difference-in-difference approach to determine whether waitlists were associated with increases in (1) the probability of having any ED visits in a given month, (2) the number of ED visits in a given month, and (3) ED visit length of stay among Medicaid enrollees with SMI statewide or regionally. In both studies, unadjusted analyses indicated that the mean number of ED visits in a given month and ED visit length of stay did not change post-waitlist by any clinically meaningful amount. However, statewide analyses (Chapter 3) found that Medicaid enrollees with SMI experienced a relative 18.9% increase in the probability of having any behavioral health-related ED visits in a given month during the post-waitlist period (5.3% pre-waitlist vs. 6.3% post-waitlist, $p<0.001$). The regional analysis (Chapter 4) revealed that these relative changes ranged across state hospital regions from 5.4% to 26.4% (both at $p<0.001$).

In both studies examining the effects of waitlists on ED use by Medicaid enrollees with SMI, difference-in-difference models indicated that waitlists were generally associated with small increases in ED utilization outcomes. In the statewide analysis, waitlists were associated with a 0.9% increase in the probability of having any ED visits in a given month (overall or behavioral health-related, both at $p<0.001$). Waitlists were also associated with 0.12 day and 0.27 day increases in ED length of stay for all ED visits and behavioral health-related ED visits, respectively (both at $p<0.001$). Post-waitlist increases in the number of ED visits in a given month were not clinically meaningful. Across regions, the effects of waitlists ranged from no effect to a 0.7% increase in the probability of any behavioral health-related ED visits in a given month ($p<0.05$). Effects of waitlists on length of stay for all ED visits ranged from no effect to a 0.222 day increase in ED length of stay ($p<0.01$). Effects of waitlist implementation on behavioral health-related ED length of stay also ranged from no effect to a 0.366 day increase in length of stay ($p<0.01$).

Implications of findings and directions for future research

Although the current study found limited internal effects of waitlists on state hospital use and small external effects of waitlists on general hospital ED use by Medicaid enrollees with SMI, these results should be interpreted taking into account several limitations of the individual studies. First, the analysis of ED utilization was limited to North Carolina Medicaid enrollees with SMI. Additional research is needed to determine whether results extend to other populations, such as people who are uninsured or diagnosed with other mental health and substance abuse conditions.

Similarly, all studies used data within four years post-waitlist announcement, examining the intermediate effects of the policy rather than the longer-term effects. Recent reports from North Carolina's Division of State Operated Healthcare Facilities (2012; 2013) suggest that the state hospital waitlists have continued to grow since 2010. In fiscal years 2012 and 2013, approximately 580 people in EDs were placed on a state hospital waitlist each month, with a mean wait time of more than 68 hours. Additional research is needed to determine whether effects of waitlists on EDs and other mental health service providers have increased in recent years as waitlists have grown. This follow-up research would be useful beyond North Carolina as well, as other states have also reported that people in acute psychiatric crisis can experience long delays before being admitted to a state psychiatric hospital (Keefe, 2013; Rosenthal, 2013; Timmins, 2012; Torrey et al., 2012; Judd, 2010; Torrey et al., 2008).

Taken separately, findings from the current study may be reassuring. Waitlists were associated with reductions in the number of state hospital admissions each month but were not associated with large increases in the frequency and length of stay of ED utilization. In this sense, waitlists succeeded in reducing state hospital admissions, providing state hospitals with the ability to control admissions, and therefore, control inpatient census as needed. Preventing overcrowding within state hospital treatment units is critical to ensuring that patients receive the care needed in a setting that supports crisis stabilization and recovery. At the same time, this policy does not appear to have substantially increased the burden on EDs to provide care for Medicaid enrollees with SMI. These findings are positive from the ED perspective since psychiatric patients already place an added strain on their resources (Zun, 2012; Schumacher Group, 2010; Tuttle, 2008), as well as from the

patient perspective since EDs are non-therapeutic environments and may not be the best setting for patients experiencing psychiatric crises (Stefan, 2006).

However, taken together, findings from the current study may also be disconcerting. If fewer people are receiving care in state hospitals *and* people are not visiting EDs to a much greater extent post-waitlist, then where *are* these people receiving care? It is possible that people experiencing acute psychiatric crises are increasingly receiving care in psychiatric crisis facilities, other inpatient units, or through extensive outpatient care. However, additional research is needed to confirm that people are not falling through the cracks and ending up in jails or prisons as a result of the waitlist policy.

It is possible that strains felt within EDs may be due to the failure or shortcomings of community-based mental health services, rather than state hospital waitlist policies. However, additional research needed to ensure that people with mental health and substance abuse disorders are receiving appropriate care hinges on the availability of data. Comprehensive data systems that follow patients across service providers and episodes of psychiatric crises would provide a much more complete picture of the continuum of care available to people with psychiatric disorders. With these data, interventions could be created that attempt to prevent psychiatric crises before they occur and efforts could be made to ensure that people who do experience psychiatric crises receive care in an appropriate setting without overburdening particular agencies within the mental health system. North Carolina recently unveiled a “Crisis Solutions Initiative” aimed at reducing the number and length of stay of behavioral health-related ED visits, with the long-term goal of implementing and expanding evidence-based strategies in crisis care (North Carolina Department of Health and Human Services, 2013). Evaluating this initiative in a rigorous manner would not only help to ensure that limited resources are being used effectively within North Carolina, but could also serve as a roadmap to other states that are still struggling to optimize crisis delivery systems.

The ultimate goal is to improve systems of care for people with mental health and substance abuse disorders, so that mental health systems are able to provide quality care in a manner that is safe, effective, efficient, timely, patient centered, and equitable (Institute of Medicine, 2001). As a step towards improving mental health systems of care, both the anticipated and unanticipated

consequences of policies and their impact on the way services are delivered must be understood, recognizing that policies might work to improve some aspects of service delivery while creating problems for other parts of the system. This study's evaluation of the internal and external effects of a waitlist policy serves as an example of how systems thinking can help to guide learning about how mental health systems function. These results are nationally relevant as the underlying issues about design and operation of public sector mental health services are issues that will loom large for all state systems in the future. By taking a systems perspective, states will be in a better position to design effective and efficient mental health service systems that are able to meet patient needs in appropriate ways without burdening particular service settings with disproportionate or dysfunctional demands.

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APPENDIX A

Supplemental information for dissertation Chapter 2:

Pre- and post-waitlist samples by state psychiatric hospital

The first study of this dissertation draws on North Carolina state hospital utilization data from January 1, 2004 through November 30, 2010. The post-waitlist period was defined in two ways: based on date of *implementation* at each state hospital and based on date of statewide policy *announcement*. Here, date of implementation is defined as beginning on the first day of the first month in which each state hospital operated on a waitlist for at least five days out of the month. Given this definition, the number of months in the pre-waitlist and post-waitlist periods varied for each hospital, as depicted in Supplemental Figure 2.1. The same is true for the second and third studies of this dissertation, although 11 fewer months of data are available in each state hospital's post-waitlist period (since these studies draw on Medicaid data through December 31, 2009).

Throughout this dissertation, time series plots are used to graphically examine changing trends in ED and state hospital utilization over time. In the plots defining the post-waitlist period based on date of *announcement*, a vertical line at the start of month 38 is included to indicate the month in which the policy was announced (February 2007). In the plots defining the post-waitlist period based on date of *implementation*, a vertical line at the start of month 52 is included to indicate the start of the post-waitlist period, with each state psychiatric hospital's pre- and post-waitlist periods centered at the vertical line. For example, the month immediately preceding the vertical line should not be interpreted as January 2007 (the month preceding waitlist policy announcement), but rather should be interpreted as one month pre-waitlist implementation, which varies by state hospital. Based on this centering, month 1 of the time series plots only includes data from Cherry Hospital and month 98 of the plots only includes data from Broughton Hospital. Months 15 through 84 of the time series plots reflect data from all state hospital regions.

Full regression results from main analysis

Full regression results from the main analysis of Chapter 2 are provided in Supplemental Table 2.1.

Sensitivity analysis using data from Medicaid enrollee state hospital admissions

As noted in the main text of Chapter 2, a sensitivity analysis that focused only on state hospital admissions by Medicaid enrollees was conducted in an effort to parallel this dissertation's other two studies, which examined post-waitlist changes in the frequency and length of stay of ED visits among Medicaid enrollees with SMI. In this sensitivity analysis, admissions were included if the state hospital visit record had Medicaid listed as a payment source, regardless of whether other payment sources were also provided.

Over the full study period, 31.6% of state hospital admissions (n=22,736 of 72,035 total admissions) were by people with Medicaid coverage. Unadjusted comparisons of the monthly number of admissions by people with Medicaid, as well as the number and proportion of monthly Medicaid admissions by people with SMI diagnoses are provided in Supplemental Table 2.2. Based on these results, the mean number of monthly Medicaid admissions decreased from 81.6 admissions pre-waitlist to 54.9 admissions post-waitlist implementation, for a relative decline of 32.7% ($p<0.001$). Monthly admissions by Medicaid enrollees with SMI also decreased post-waitlist implementation (60.6 pre-waitlist vs. 42.5 post-waitlist, $p<0.001$), with the percent of monthly Medicaid admissions by people with SMI increasing by a relative 5.5% (74.3% pre-waitlist vs. 78.4% post-waitlist, $p<0.001$). Similar results were found when the post-waitlist period was defined based on date of policy announcement.

Regression results examining the effects of waitlists on the number of monthly Medicaid admissions (overall and by people with SMI) as well as the percent of monthly Medicaid admissions by people with SMI are provided in Supplemental Table 2.3. These results are consistent with results reported in Chapter 2. Specifically, waitlists were associated with decreases in the number of monthly admissions by Medicaid enrollees (overall and by people with SMI) but were not associated with any changes in the percent of monthly Medicaid admissions by people with SMI.

Supplemental Table 2.1: Full regression output from state hospital-level fixed effects models

Variable	Defining post-waitlist period based on date of policy implementation (n=332)			Defining post-waitlist period based on date of policy announcement (n=328)		
	Total number of admissions	Number of admissions with SMI	Percent of admissions with SMI	Total number of admissions	Number of admissions with SMI	Percent of admissions with SMI
Post-waitlist (reference: pre-waitlist)	-53.1***	-31.8***	-0.4	-56.0***	-33.3***	-0.6
Linear time trend * post-waitlist	-1.6*	-1.4***	0.0	-3.4***	-2.2***	0.2
Time trends						
Linear time trend	-0.9*	-0.1	0.1	-0.1	0.2	0.0
Monthly seasonality (reference: January)						
February	-30.7***	-16.6***	1.1	-28.7***	-12.3**	2.2
March	-8.3	-1.8	1.8	3.1	2.1	2.2
April	12.0	-6.9	1.4	8.0	-3.9	1.6
May	-0.9	-2.2	0.3	0.2	-0.5	0.7
June	8.6	1.3	-0.5	6.7	1.7	0.0
July	18.5	6.5	-0.6	16.7	7.2	0.0
August	13.4	8.7	1.1	13.0	9.9	1.6
September	-8.4	-4.5	1.6	-7.8	-3.0	1.9
October	-2.8	0.7	2.1	-2.5	2.3	2.5
November	-34.2***	-19.8***	2.1	-34.4***	-18.2***	2.6*
December	-30.8***	-16.5**	2.6	-30.9**	-14.8*	3.1
Demographic composition						
Sex						
Proportion male	1510.4	3242.5	-147.9	-15332.7	-6610.1	-616.1
Age						
Proportion aged 20-29	-9999.8*	-4957.9*	1352.4*	-5335.5	-1619.6	1430.7*
Proportion aged 30-64	-13118.4**	-6025.0**	495.3	-10172.3**	-4320.6*	480.6
Proportion aged 65+	-1892.7	-1068.6	798.4*	190.6	756.0	982.2*
Race						
Proportion black	-507.2	132.3	104.0	-1057.0	-242.0	132.3
Proportion other minority	-1402.2**	-589.3*	263.6**	-1283.9**	-343.2	275.3***
Unemployment rate	-1092.1***	-517.0***	75.4	-833.4***	-478.1***	28.7
Mental health resources (per 100,000 population)						
Number of psychiatrists	2.2	1.9	1.2**	-1.7	0.0	1.3*
Number of general hospital psychiatric unit or private psychiatric hospital beds	-4.9*	-5.1***	-0.7	-2.9	-4.1**	-0.6
Constant	9154.4	2349.9	-449.1	13679.8	5706.1	260.3

* p<0.05
** p<0.01
*** p<0.001

Supplemental Table 2.2: Monthly admissions to North Carolina state psychiatric hospitals pre- and post-waitlist between January 2004 and November 2010 by Medicaid enrollees

Summary statistic	Defining post-waitlist period based on date of policy implementation (n=332)			Defining post-waitlist period based on date of policy announcement (n=328)		
	Pre-waitlist	Post-waitlist	% change (unadjusted) (p-value)	Pre-waitlist	Post-waitlist	% change (unadjusted) (p-value)
Mean number of Medicaid admissions to state hospitals each month	81.6	54.9	-32.7% (p<0.001)	81.2	57.8	-28.8% (p<0.001)
Mean number of Medicaid admissions with SMI to state hospitals each month	60.6	42.5	-29.9% (p<0.001)	60.0	44.8	-25.3% (p<0.001)
Percent of monthly Medicaid admissions with SMI	74.3	78.4	5.5% (p<0.001)	73.9	78.4	6.1% (p<0.001)

Supplemental Table 2.3: State hospital-level fixed effects regression estimates of the effect of the waitlist policy on the number and case mix of monthly admissions by Medicaid enrollees

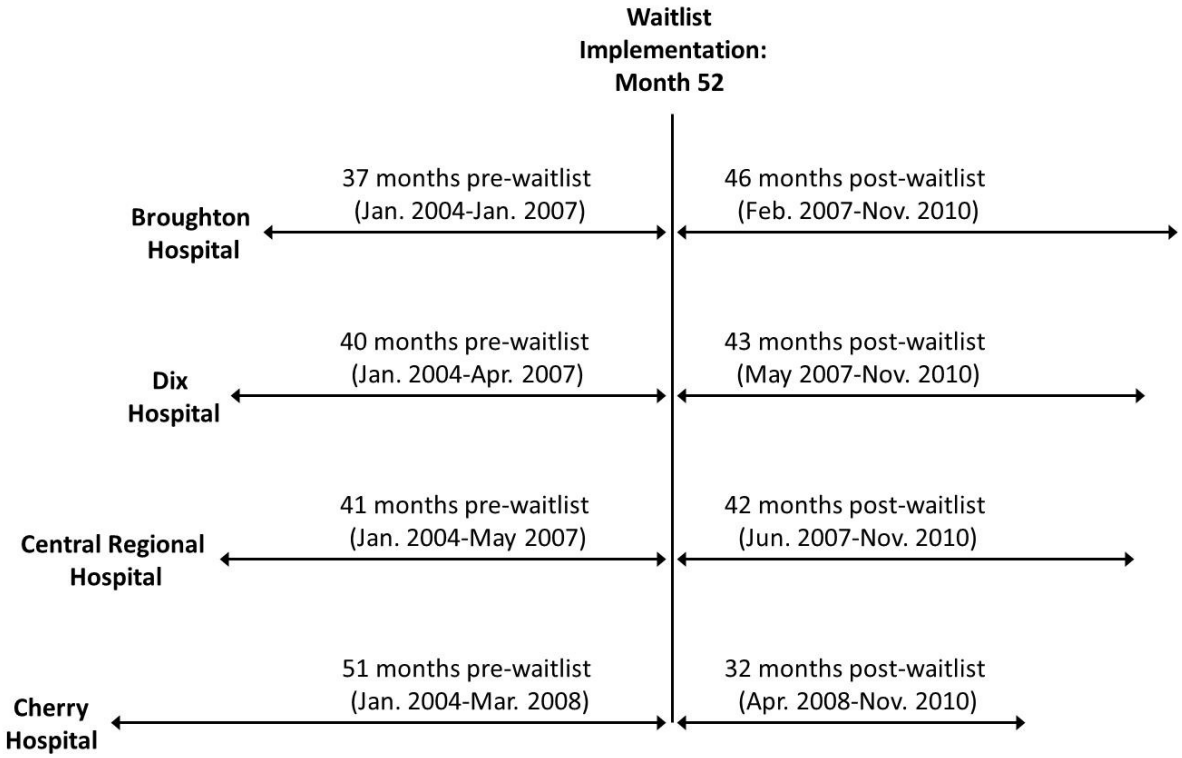
Variable[a]	Defining post-waitlist period based on date of policy implementation (n=332)			Defining post-waitlist period based on date of policy announcement (n=328)		
	Total number of Medicaid admissions	Number of Medicaid admissions with SMI	Percent of Medicaid admissions with SMI	Total number of Medicaid admissions	Number of Medicaid admissions with SMI	Percent of Medicaid admissions with SMI
Post-waitlist (reference: pre-waitlist)	-19.4***	-15.2***	-0.6	-14.0***	-12.6***	-3.2
Time trend * post-waitlist	-1.5***	-1.2***	0.0	-1.8***	-1.3***	0.2

* p<0.05
** p<0.01
*** p<0.001

Notes:

[a] Other independent variables controlled for time trends (linear time trend and calendar month), demographic composition of the population (sex, age, and race), regional unemployment rate, and mental health services within regions (number of licensed psychiatrists per 100,000 population and number of licensed adult psychiatric beds in general hospital psychiatric units or private psychiatric hospitals per 100,000 population).

Supplemental Figure 2.1: Graphic representation of pre- and post-waitlist time periods by state hospital, based on date of policy implementation



APPENDIX B

Supplemental information for dissertation Chapter 4:

Average marginal effects of waitlist policy separately for treatment and control groups

Average marginal effects from the difference-in-difference analyses of Chapter 4 are provided separately for treatment and control groups in Supplemental Tables 4.1, 4.2, and 4.3. These tables provide average marginal effects for the models of any emergency department (ED) visits in a given month, number of ED visits in a given month, and ED visit length of stay, respectively.

Supplemental Table 4.1: Average marginal effects of the waitlist policy on probability of having any ED visits in month by Medicaid enrollees with SMI separately for treatment and control groups, by state hospital region

Analysis scenario	Post-waitlist average marginal effect (standard error)[a]							
	Any ED visits in month, %				Any behavioral health-related ED visits in month, %[b]			
	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region
Main Analysis: Defining post-waitlist period based on date of waitlist implementation								
Treatment group of adults aged 18-64	-0.416*** (0.00)	-1.115*** (0.00)	-0.203 (0.00)	0.361** (0.00)	-0.631*** (0.00)	-0.411*** (0.00)	-0.530*** (0.00)	0.002 (0.00)
Control group of adults aged 65-74	-1.048** (0.00)	-1.858*** (0.00)	-0.750 (0.01)	-0.419 (0.01)	-0.479* (0.00)	-0.781** (0.00)	-0.987* (0.00)	-0.868* (0.00)
Main Analysis: Defining post-waitlist period based on date of policy announcement								
Treatment group of adults aged 18-64	-0.396*** (0.00)	-0.947*** (0.00)	-0.602*** (0.00)	0.110 (0.00)	-0.634*** (0.00)	-0.420*** (0.00)	-0.519*** (0.00)	0.058 (0.00)
Control group of adults aged 65-74	-1.015** (0.00)	-2.160*** (0.00)	-0.382 (0.00)	-0.608 (0.00)	-0.483* (0.00)	-0.797** (0.01)	-0.007** (0.00)	-0.653* (0.00)
Sensitivity Analysis 1: Defining "behavioral health-related" ED visits based on first-listed diagnoses								
Treatment group of adults aged 18-64	--	--	--	--	-0.456*** (0.00)	-0.126* (0.00)	-0.213** (0.00)	0.098 (0.00)
Control group of adults aged 65-74	--	--	--	--	-0.219 (0.00)	-0.702** (0.00)	-0.422 (0.00)	-0.491 (0.00)
Sensitivity Analysis2: Defining "behavioral health-related" ED visits based on procedure codes								
Treatment group of adults aged 18-64	--	--	--	--	-0.032 (0.00)	0.003 (0.00)	0.471*** (0.00)	0.119* (0.00)
Control group of adults aged 65-74	--	--	--	--	0.223** (0.00)	-0.099 (0.00)	0.145 (0.00)	0.068 (0.00)
Sensitivity Analysis 3: Including statewide psychiatric beds in state hospitals per 100,000 population as control variable								
Treatment group of adults aged 18-64	-0.047 (0.00)	-0.914*** (0.00)	0.302 (0.00)	0.709*** (0.00)	0.037 (0.00)	-0.141 (0.00)	-0.367** (0.00)	-0.038 (0.00)
Control group of adults aged 65-74	-0.678 (0.00)	-1.655*** (0.00)	-0.233 (0.01)	-0.064 (0.01)	0.191 (0.00)	-0.507 (0.00)	-0.819 (0.00)	-0.909** (0.00)

(Continued)

Supplemental Table 4.1: *(Continued)*

Analysis scenario	Post-waitlist average marginal effect (standard error)[a]							
	Any ED visits in month, %				Any behavioral health-related ED visits in month, %[b]			
	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region
Sensitivity Analysis 4: Including regional psychiatric beds in state hospitals per 100,000 population as control variable								
Treatment group of adults aged 18-64	-0.410*** (0.00)	-1.113*** (0.00)	-0.212 (0.00)	0.230 (0.00)	-0.630*** (0.00)	-0.410*** (0.00)	-0.540*** (0.00)	-0.059 (0.00)
Control group of adults aged 65-74	-1.042** (0.00)	-1.865*** (0.00)	-0.760 (0.01)	-0.548 (0.01)	-0.478* (0.00)	-0.784** (0.00)	-0.998* (0.00)	-0.929** (0.00)
Sensitivity Analysis 5: Excluding people with major depression from sample of Medicaid enrollees with SMI								
Treatment group of adults aged 18-64	-0.373** (0.00)	-1.088*** (0.00)	-0.067 (0.00)	0.523*** (0.00)	-0.649*** (0.00)	-0.431** (0.00)	-0.601*** (0.00)	0.091 (0.00)
Control group of adults aged 65-74	-1.087** (0.00)	-2.220*** (0.01)	-0.561 (0.01)	-0.712 (0.01)	-0.397 (0.00)	-0.846** (0.00)	-1.348** (0.01)	-1.118** (0.00)
Sensitivity Analysis 6: Using adolescents aged 13-17 years as control group								
Treatment group of adults aged 18-64	-0.470*** (0.00)	-1.003*** (0.00)	-0.116 (0.00)	0.354** (0.00)	-0.654*** (0.00)	-0.351*** (0.00)	-0.483*** (0.00)	0.022 (0.00)
Control group of adolescents aged 13-17	-0.095 (0.00)	-1.488*** (0.00)	-1.109*** (0.00)	-0.146 (0.00)	0.074 (0.00)	-0.459*** (0.00)	-0.812*** (0.00)	-0.168 (0.00)

* p<0.05

** p<0.01

*** p<0.001

Notes:

[a] Average marginal effects estimated using linear probability models; standard errors estimated using 100 bootstrap replications. In all models, other independent variables controlled for time trends (linear time trend and calendar month of observation), person-level characteristics (enrollee age at beginning of month; sex; race; ethnicity; dual eligible insurance status; SMI diagnoses; number of comorbid medical, mental health, and substance abuse conditions), and county-level characteristics (unemployment rate, number of licensed psychiatrists per 100,000 population, and number of licensed adult psychiatric beds in general hospital psychiatric units/private psychiatric hospitals per 100,000 population) unless otherwise noted.

[b] Behavioral health-related ED visits were defined based on the presence of a mental health or substance abuse diagnosis listed anywhere in the ED visit record, with the exception of sensitivity analyses 1 and 2.

Supplemental Table 4.2: Average marginal effects of the waitlist policy on number of ED visits in month by Medicaid enrollees with SMI separately for treatment and control groups, by state hospital region

Analysis scenario	Post-waitlist average marginal effect (standard error)[a]							
	Number of ED visits in month				Number of behavioral health-related ED visits in month[b]			
	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region
Main Analysis: Defining post-waitlist period based on date of waitlist implementation								
Treatment group of adults aged 18-64	-0.008*** (0.00)	-0.017*** (0.00)	-0.006* (0.00)	0.009*** (0.00)	-0.011*** (0.00)	-0.006*** (0.00)	-0.003** (0.00)	0.001 (0.00)
Control group of adults aged 65-74	-0.024*** (0.01)	-0.024*** (0.00)	-0.016* (0.01)	-0.016 (0.01)	-0.008* (0.00)	-0.004* (0.00)	-0.007** (0.00)	-0.009** (0.00)
Main Analysis: Defining post-waitlist period based on date of policy announcement								
Treatment group of adults aged 18-64	-0.008*** (0.00)	-0.015*** (0.00)	-0.014*** (0.00)	0.003 (0.00)	-0.011*** (0.00)	-0.006*** (0.00)	-0.005*** (0.00)	0.001 (0.00)
Control group of adults aged 65-74	-0.024*** (0.01)	-0.030*** (0.01)	-0.015* (0.00)	-0.018 (0.01)	-0.008** (0.00)	-0.005 (0.00)	-0.008** (0.00)	-0.007* (0.00)
Sensitivity Analysis 1: Defining "behavioral health-related" ED visits based on first-listed diagnoses								
Treatment group of adults aged 18-64	--	--	--	--	-0.005*** (0.00)	-0.002** (0.00)	-0.003** (0.00)	0.001 (0.00)
Control group of adults aged 65-74	--	--	--	--	-0.001 (0.00)	-0.003* (0.00)	-0.006* (0.00)	-0.006* (0.00)
Sensitivity Analysis2: Defining "behavioral health-related" ED visits based on procedure codes								
Treatment group of adults aged 18-64	--	--	--	--	-0.001* (0.00)	0.000 (0.00)	0.005*** (0.00)	0.001 (0.00)
Control group of adults aged 65-74	--	--	--	--	0.002* (0.00)	-0.001 (0.00)	0.000 (0.00)	-0.001 (0.00)
Sensitivity Analysis 3: Including statewide psychiatric beds in state hospitals per 100,000 population as control variable								
Treatment group of adults aged 18-64	0.001 (0.00)	-0.011*** (0.00)	0.004 (0.00)	0.019*** (0.00)	0.001 (0.00)	-0.001 (0.00)	0.000 (0.00)	0.001 (0.00)
Control group of adults aged 65-74	-0.018** (0.01)	-0.021*** (0.00)	-0.011 (0.01)	-0.008 (0.01)	-0.002 (0.00)	-0.002 (0.00)	-0.006* (0.00)	-0.009** (0.00)

(Continued)

Supplemental Table 4.2: *(Continued)*

Analysis scenario	Post-waitlist average marginal effect (standard error)[a]							
	Number of ED visits in month				Number of behavioral health-related ED visits in month[b]			
	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region
Sensitivity Analysis 4: Including regional psychiatric beds in state hospitals per 100,000 population as control variable								
Treatment group of adults aged 18-64	-0.008*** (0.00)	-0.019*** (0.00)	-0.006* (0.00)	0.006* (0.00)	-0.011*** (0.00)	-0.007*** (0.00)	-0.003** (0.00)	0.000 (0.00)
Control group of adults aged 65-74	-0.024*** (0.01)	-0.027*** (0.01)	-0.017* (0.00)	-0.018 (0.01)	-0.008* (0.00)	-0.005* (0.00)	-0.007** (0.00)	-0.010** (0.00)
Sensitivity Analysis 5: Excluding people with major depression from sample of Medicaid enrollees with SMI								
Treatment group of adults aged 18-64	-0.006** (0.00)	-0.017*** (0.00)	-0.005 (0.00)	0.013*** (0.00)	-0.011*** (0.00)	-0.007*** (0.00)	-0.004** (0.00)	0.002 (0.00)
Control group of adults aged 65-74	-0.027*** (0.01)	-0.028*** (0.01)	-0.015 (0.01)	-0.024** (0.01)	-0.007 (0.00)	-0.005 (0.00)	-0.009** (0.00)	-0.011** (0.00)
Sensitivity Analysis 6: Using adolescents aged 13-17 years as control group								
Treatment group of adults aged 18-64	-0.009*** (0.00)	-0.015*** (0.00)	-0.005* (0.00)	0.009** (0.00)	-0.011*** (0.00)	-0.006*** (0.00)	-0.003** (0.00)	0.001 (0.00)
Control group of adults aged 65-74	-0.002 (0.00)	-0.012*** (0.00)	-0.006** (0.00)	-0.003 (0.00)	0.000 (0.00)	-0.004** (0.00)	-0.002* (0.00)	-0.001 (0.00)

* p<0.05

** p<0.01

*** p<0.001

Notes:

[a] Average marginal effects estimated using hurdle models; standard errors estimated using 100 bootstrap replications. In all models, other independent variables controlled for time trends (linear time trend and calendar month of observation), person-level characteristics (enrollee age at beginning of month; sex; race; ethnicity; dual eligible insurance status; SMI diagnoses; number of comorbid medical, mental health, and substance abuse conditions), and county-level characteristics (unemployment rate, number of licensed psychiatrists per 100,000 population, and number of licensed adult psychiatric beds in general hospital psychiatric units/private psychiatric hospitals per 100,000 population) unless otherwise noted.

[b] Behavioral health-related ED visits were defined based on the presence of a mental health or substance abuse diagnosis listed anywhere in the ED visit record, with the exception of sensitivity analyses 1 and 2.

Supplemental Table 4.3: Average marginal effects of the waitlist policy on ED length of stay for Medicaid enrollees with SMI separately for treatment and control groups, by state hospital region

Analysis scenario	Post-waitlist average marginal effect (standard error)[a]							
	ED visit length of stay, days				Behavioral health-related ED visit length of stay, days[b]			
	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region
Main Analysis: Defining post-waitlist period based on date of waitlist implementation								
Treatment group of adults aged 18-64	-0.013 (0.01)	-0.051*** (0.01)	-0.049** (0.02)	-0.041* (0.02)	-0.023* (0.01)	-0.094** (0.03)	-0.092** (0.03)	-0.110** (0.03)
Control group of adults aged 65-74	-0.235*** (0.05)	-0.133* (0.06)	-0.121 (0.07)	-0.128* (0.05)	-0.389*** (0.11)	-0.433** (0.14)	-0.210 (0.16)	-0.394* (0.15)
Main Analysis: Defining post-waitlist period based on date of policy announcement								
Treatment group of adults aged 18-64	-0.013 (0.01)	-0.076*** (0.02)	-0.055** (0.02)	-0.010 (0.02)	-0.021* (0.01)	-0.132** (0.05)	-0.074** (0.03)	-0.040 (0.03)
Control group of adults aged 65-74	-0.232*** (0.05)	-0.188** (0.07)	-0.315** (0.09)	-0.199** (0.06)	-0.386*** (0.10)	-0.522** (0.16)	-0.485* (0.23)	-0.603** (0.23)
Sensitivity Analysis 1: Defining "behavioral health-related" ED visits based on first-listed diagnoses								
Treatment group of adults aged 18-64	--	--	--	--	-0.045* (0.02)	-0.108*** (0.02)	-0.103* (0.05)	-0.145** (0.04)
Control group of adults aged 65-74	--	--	--	--	-0.530* (0.21)	-0.489* (0.21)	-0.144 (0.24)	-0.177 (0.26)
Sensitivity Analysis2: Defining "behavioral health-related" ED visits based on procedure codes								
Treatment group of adults aged 18-64	--	--	--	--	0.005 (0.01)	-0.033* (0.01)	-0.005 (0.03)	-0.023** (0.01)
Control group of adults aged 65-74	--	--	--	--	0.121 (2.19)	-0.074 (0.26)	0.224 (1.56)	0.107 (0.14)
Sensitivity Analysis 3: Including statewide psychiatric beds in state hospitals per 100,000 population as control variable								
Treatment group of adults aged 18-64	0.018 (0.01)	-0.017 (0.01)	-0.008 (0.03)	-0.002 (0.02)	0.015 (0.01)	-0.055* (0.03)	-0.035 (0.05)	-0.055 (0.04)
Control group of adults aged 65-74	-0.115* (0.05)	-0.046 (0.06)	-0.041 (0.09)	-0.063 (0.06)	-0.144 (0.08)	-0.322* (0.13)	-0.010 (0.23)	-0.262 (0.16)

(Continued)

Supplemental Table 4.3: *(Continued)*

Analysis scenario	Post-waitlist average marginal effect (standard error)[a]							
	ED visit length of stay, days				Behavioral health-related ED visit length of stay, days[b]			
	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region	Broughton Western Region	Central Regional North Central Region	Cherry Eastern Region	Dix South Central Region
Sensitivity Analysis 4: Including regional psychiatric beds in state hospitals per 100,000 population as control variable								
Treatment group of adults aged 18-64	-0.012 (0.01)	-0.094*** (0.02)	-0.053** (0.02)	-0.028 (0.02)	-0.022* (0.01)	-0.178*** (0.05)	-0.099** (0.03)	-0.101** (0.03)
Control group of adults aged 65-74	-0.223*** (0.05)	-0.237* (0.10)	-0.136 (0.07)	-0.106 (0.06)	-0.377*** (0.10)	-0.724** (0.24)	-0.245 (0.19)	-0.374* (0.16)
Sensitivity Analysis 5: Excluding people with major depression from sample of Medicaid enrollees with SMI								
Treatment group of adults aged 18-64	-0.020 (0.02)	-0.044** (0.01)	-0.052* (0.02)	-0.047* (0.02)	-0.025* (0.01)	-0.064* (0.03)	-0.098* (0.04)	-0.120** (0.04)
Control group of adults aged 65-74	-0.230*** (0.06)	-0.220** (0.06)	-0.177** (0.05)	-0.119 (0.07)	-0.429** (0.14)	-0.533** (0.16)	-0.233 (0.18)	-0.364 (0.19)
Sensitivity Analysis 6: Using adolescents aged 13-17 years as control group								
Treatment group of adults aged 18-64	-0.013 (0.01)	-0.051*** (0.01)	-0.050** (0.02)	-0.039* (0.02)	-0.022* (0.01)	-0.093** (0.03)	-0.092** (0.03)	-0.108** (0.03)
Control group of adolescents aged 13-17	-0.013 (0.01)	0.024 (0.03)	0.011 (0.03)	0.011 (0.01)	-0.025 (0.02)	0.035 (0.07)	0.225 (0.32)	0.006 (0.04)

* p<0.05

** p<0.01

*** p<0.001

Notes:

[a] Average marginal effects estimated using hurdle models; standard errors estimated using 100 bootstrap replications. In all models, other independent variables controlled for time trends (linear time trend and calendar month of observation), person-level characteristics (enrollee age at beginning of month; sex; race; ethnicity; dual eligible insurance status; SMI diagnoses; number of comorbid medical, mental health, and substance abuse conditions), and county-level characteristics (unemployment rate, number of licensed psychiatrists per 100,000 population, and number of licensed adult psychiatric beds in general hospital psychiatric units/private psychiatric hospitals per 100,000 population) unless otherwise noted.

[b] Behavioral health-related ED visits were defined based on the presence of a mental health or substance abuse diagnosis listed anywhere in the ED visit record, with the exception of sensitivity analyses 1 and 2.