A Methodology for Analyzing Healthcare Utilization among College Students with Mental Health Disorders

A Thesis

Presented to

the faculty of the School of Engineering and Applied Science

University of Virginia

in partial fulfillment

of the requirements for the degree

Master of Science

by

Hao Wu

August

2015

APPROVAL SHEET

The thesis

is submitted in partial fulfillment of the requirements

for the degree of

Master of Science

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August

2015

Abstract

Over the past decade, the prevalence and severity of mental health disorders have been growing among the college student population. Because psychological disorders and maladjustment can disrupt students' academic, emotional and social lives, as well as the university community as a whole, most colleges and universities in the US have counseling centers that provide behavioral health services. However, surveys show that only a meager 18% of students with mental health problems are receiving proper treatment, whiles Student Health Centers (SHCs) struggled with offering adequate healthcare service to meet the treatment need from patients. Despite devoting significant resources to the provision of mental health services, there is no consensus about how these services should be integrated with medical health services.

This unique study investigates how information sharing between behavioral and medical services influences the utilization of healthcare service by mental health patients in American universities. Specifically, we used de-identified electronic health records (EHRs) data of 21 schools participating in the College Health Surveillance Network (CHSN) Project from January 1, 2011 through May 31, 2014, which include ICD-9 diagnostic codes and CPT procedure records of over 717,370 students with over 3.9 million visits. Then, we defined two levels of service integration: "standard" for universities with separate information systems and minimum clinical collaboration between medical and behavioral health services; "enhanced" for universities with an integrated EHR and consistent clinical collaboration between services. We proposed two measures of efficiency: frequency, defined as the total number of primary care visits per unit time, was compared using a negative binomial multilevel model; while complexity, defined as total visit length for primary care visits per unit time, was compared using a linear multilevel model.

Statistical models showed that, when controlling for the variance in age, sex and total time in school, patients with a mental health diagnosis in standard systems had 15.58% (95% CI, 10.77% -20.44%) more primary care visits and spend 22.89% (95% CI, 21.42% -24.38%) more time than patients in the enhanced systems. This study demonstrates significantly lower utilization by college students with mental health disorders in an enhanced clinical integration service system, suggesting that patient care could be improved and cost reduced if institutions of higher education adopted the integrated health care. The contribution of this work is a novel framework to incorporate multisite electronic health data to study utilization of different health care models. Future work includes predictive modeling of utilization patterns in different care models and extending the study to specific patient subgroups.

Acknowledgements

Coming to University of Virginia is one of the most important decisions I made, and I feel fortunate that I have been here, and never regret. I would like to thank a few of the many people who have helped me during the past two years. First and foremost, I would like to acknowledge my advisor, Laura Barnes. Professor Barnes has played a lot of roles in many ways, from my research advisor, my teacher, to a sister and a mentor in my life. I cannot imagine my study here without her continuous support, insightful thoughts, and patient guidance. She was instrumental in formulating this work and vital in my successful completion of this program. Without her positive influence, I could not improve my problem solving ability and my way of thinking so much during my time here.

The CHSN team is amazing and deserves more thanks than I can give for their help in completing this research. Dr. Adrienne Keller and Dr. James Turner provided invaluable support and constant steering of the research from day one. Dr. Keller's bright face is like sunshine to me, I appreciate her quick help whenever I needed, and also the time she invested in me. For Dr. Turner, his passion for this work and the relentless pursuit in quality impacted me a lot.

My committee chair, Dr. Donald Brown has been incredible helpful in my study here. He always offers insights and sharp comments for my problems, and I am inspired by the way he kept challenging me. I really admire his enthusiasm and critical thinking ability.

Also, I want to thank all the mentors I met in Charlottesville: Dr. William Scherer, Dr. Yacov Haimes, Dr. Hongning Wang, Dr. Quanquan Gu imparted invaluable knowledge in class; and Mr. Patrick Harrison guided me through two real-world projects during internship. I have learnt so much from them, now I am proud to say that I am a capable system engineer.

Additionally, thank you all my dearest friends who have accompanied me for two years and the years to come: Jinghe Zhang, Muhammad Ammar Hassan, Lin Gong, Junrui Xu, Yang Wang, Jason Payne, Yuxiang Wang, Yuzheng Liu, Robert Ferrari and others. We shared so many happy memories together and this journey became so unforgettable because of you.

Last but not least, I want to thank my parents Qijian Wu and Lihong Wang, my boyfriend Shiyang Chen and his family for their unconditional love. Thank you so much.

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1 INTRODUCTION

Mental Health Disorder (MHD) problems are highly prevalent among college student populations and likely increasing in frequency and severity.[1–4] In the 2013 National Survey of Counseling Centers, 95 percent of college directors express concerns about their centers when confronting with a steady growth in the number of students with severe psychological problems.[1] Meanwhile, in 2014 spring, the American College Health Association reported that 39 percent of college students felt "things were hopeless" and over 77 percent reported feeling "overwhelming anxiety" or "exhausted" at least once in the preceding year.[5] These mental health problems have imposed enormous academic, financial, health, and social costs on students with MHD, including lower academic achievement, higher dropout rates, and learning difficulties.[6] Suicide has also become one of the leading causes of death among college students.[7] As a result, more and more colleges and universities in the United States have counseling centers that provide behavioral health services. However, only a meager of 18.45 percent college student with any types of MHD received proper treatment within the past twelve monthes,[8] while Student Health Centers (SHCs) struggled with offering adequate healthcare service to meet the treatment need from students with MHD.[9]

In fact, psychiatric disorders are frequently unrecognized in primary care (PC) settings.[10–12] Primary care is the foundation of the U.S. health care system. It is a healthcare services that offered by primary care physicians or nurse practitioners to serve as individuals' first point of contact with healthcare system and as the continuing source for all needs for healthcare services.[13] Primary care services evolve both logistics and human resources, which are expensive; and primary care visits contributes 55 percent of the one billion physician office visits each year in the

United States.[14] However, more than 50 percent of patient with severe depression are not diagnosed accurately by physicians in a primary care environment.[15] As a result, patients receive treatments for somatic complaints but not an identification and/or treatment for the real cause–depression,[16] which lead to increased use of health resources and impaired health-related quality of life.[17] These findings are in accordance with a fact that as many as 70 percent of primary care visits stem from the underlying psychosocial issues.[18]

Despite devoting significant resources to the provision of mental health services, there is no consensus about how these services should be integrated with medical services.[9,19,20] Although some studies have supported the integration of mental health and medical services in non-college populations,[21,22] little has been published regarding the potential benefit of such integration on college campus.[19,23] Only 26 percent of college counseling centers nationally are administratively integrated within a student health service, 29 percent collaborate extensively on patient/client care with the campus health service, and 19.9 percent permit access to counseling or psychiatry records by other student health providers.[20]

Categorizing the degree of integration between mental health and medical services is challenging because of lack of standard terminology as well as the breadth and variability of integration along the continuum of care within health systems.[24] Fully integrated care of all primary care visits, in which there is one treatment plan with mental health and medical elements, managed by a team,[24] is an uncommon model in college health. However, some models of integrated care preserve specialized clinical roles for primary care and behavioral health providers, but have enhanced referral relationships and routine exchange of information between treatment settings.[25] Close collaboration among providers allows direct communication and a sense of being part of a larger team with shared common systems (e.g., facility, scheduling, medical records).[25–27]

To address the dilemma of the healthcare provision on college campus, it is of utmost importance to ensure that the highest quality of care is delivered and that the waste of healthcare resources and costs are minimized during that process. Given the characteristics of this sub-population and their unique health concerns, this work examines the macro-level national trends in utilization of primary care services by mental health diagnosed population, and evaluates the potential influence of integration of behavioral and medical services on a college campus. To sum up, this study addresses the following research question: Does the use of primary care services of students with MHD differ significantly by service integration model, as measured by frequency and complexity of primary care visits?

2 METHOD

This section begins with an introduction of the CHSN database, related data quality issues and then the data cleaning processes. We design the study framework based on available data. In the sample section, we provide details regarding how we select the final sample patients from the initial population. Then we define three variables that are critical in this study and explain the two main outcome measures (frequency/complexity) to evaluate healthcare utilization. At last, we discuss our two primary hypotheses and the development of two multilevel regression models to test each hypothesis.

2.1. Data Summary

2.1.1. Data Source

This study used de-identified electronic health records (EHRs) data from schools participating in the College Health Surveillance Network (CHSN). Recruited from among members of the American College Health Association (ACHA) via email, twenty three college health services [Carnegie Research Universities/Very High classification (RU/VH)] have joined CHSN since October 2010. These schools represent approximately 717,370 unique patients with over 3.9 million unique visits from January 1, 2011 through May 31, 2014 (41 months), representing all geographic regions of the United States[I]. The database presents the first opportunity to examine longitudinal data that can be used to study health and utilization patterns among the college student population. The demography of enrolled students (sex, race/ethnicity,

[I] The statistics here are based on 21 universities that are selected for this research.

age, undergraduate/graduate status) in CHSN schools matches well with the demography for the population of 108 Carnegie Research Universities/Very High classification.[28]

Each month, CHSN member schools submit EHR data of the previous month, including a confidential patient identifier, date of visit, geographic region of school, all ICD-9 diagnostic codes[29] and CPT procedural codes[30] associated with that visit, and demographic data including age, sex, ethnicity, and student status (undergraduate/graduate) of all student patient encounters. Each school developed its own confidential formula to create patient identification variables. Data abstraction programming was developed internally at each school or obtained from the EHR vendor. The medical directors of each school were asked to ensure that medical staffs in their respective health services consistently utilized ICD-9 and CPT codes to categorize diagnoses and levels of care. Most of the schools have contributed monthly data beginning January 1, 2011; two schools did not institute EHR systems until later in 2011; one school began uploads in mid-2012.[28]

2.1.2. Data Quality and Cleaning

Since CHSN data are self-uploaded by each university, the quality and consistency of coding vary across the board. This multisite database has the following data quality issues:

- **Missing records**. Not all universities joined CHSN at the beginning of our study period. Among twenty-three universities who participated CHSN since October 2010, one school did not use EHR systems until mid-2011, and the other started in mid-2012. Therefore, this study included the remaining twenty-one universities which contain complete records from January 1, 2011 to May 31, 2014.

- **Missing/Null values**. Records that have any missing or null value in age, sex, date of visit, CPT code or ICD-9 code, are not considered in the study.

- **Missing/incorrectly recorded ethnicity**. About half of the universities did not include ethnicity in their EHR system. Since the database was not connected with the registrar office at school, we were not able to obtain the ethnicity information of patients. Among the thirteen universities who had included ethnicity, one recorded all patients seen at student health center as white, which is incorrect. Therefore, when comparing the ethnicity distribution in population between two service systems (Table 1), we used ethnicity data from 2013 Fall enrollment of full time students in Integrated Postsecondary Education Data Systems as an approximate of patient ethnicity distribution.[31] Except Table 1, we did not include ethnicity in the rest of study.

- **Invalid CPT Code**. Not all schools use standard CPT code as required. CHSN database has more than 4800 unique CPT codes, but not all of them are valid. Non-standard CPT codes have many variations, such as long code greater than ten digits, dashed code containing the initials of clinicians, self-created code with no meaning, fake code (like 0,000,0000) etc. In order to filter valid CPT code, we refered to CPT Standard [32] and summarized the following rules for a standard CPT code:
    - If the first digit is in [a, A, b, B, c, C, d, D, e, E, g, G, h, H, j, J, k, K, l, L, m, M, p, P, q, Q, r, R, s, S, t, T, v, V], convert it to '99'.
    - The converted CPT code should be no longer than 6 digits.
    - After that, the first and fifth digit should be a number.
    - The overall CPT code should be all numeric, and either between [100, 99999] or greater than 990000.

In study sample, we found that about 5% CPT records were invalid based on the above rules, so they were removed from our analysis.

- **Invalid ICD-9 code**. Similar to CPT code, not all schools use standard ICD-9 code to describe the diagnosis information. Standard ICD-9 code can have both number and letters, as well as a period, which increases the variation of non-standard ICD-9 code. The database contains more than 8700 unique ICD-9 codes. In order to filter valid ICD-9 code, we referred to International Classification of Diseases- Ninth Revision website [33] and summarized the following rules for standard ICD-9 code:
    - Only the first digit can have letter (either 'E' or 'V'), and the rest of the code should be number or a period.
    - If the first digit is a number, then for the rest of the code, it contains 0-2 number(s) before the period (same for no period situation), and 0-2 number(s) after the period.
    - If the first digit is 'E', then for the rest of the code, it contains 0-3 number(s) before the period (same for no period situation), and 0-2 number(s) after the period.
    - If the first digit is 'V', then for the rest of the code, it contains 0-2 number(s) before the period (same for no period situation), and 0-2 number(s) after the period.

    In study sample, we found that about 3.5% ICD-9 records were invalid based on the above rules, so they were removed from our analysis.

- **Irregular patient id**. Patient id should consist only letters or numbers, so if a patient id has comma in between, it is considered irregular. There were about 0.01% patient ids have comma in them. We removed all commas in the patient ids and concatenated two separated parts to form a new patient id. We find that more than 90% of these modified patient ids have already existed in the database and the other patient information are identical, which confirmed our original thought that comma should be removed. Another issue is that two schools may share the same patient id, so that we used patient id plus school id to identify a unique patient, rather than using patient id only.
- **Updating age**. This problem arises when a patient has multiple visits to the SHC. The age variable in CHSN reflects the age of this patient in his/her most recent visit. All age in the previous visit records are updated to current age when there is a new visit. Since Date of births (DOBs) are not upload to CHSN as it is considered Protected Health Information,[34] we corrected this issue using Equation [1] and [2] below. To be more specific, we first calculated the gap years between a patient's first and last visit (Equation [1]), and subtracted this gap from the current age to reflect the first age when a patient encountered with SHC (Equation [2]).

$$\text{Gap} = (\text{Year in the latest visit date}) - (\text{Year in the first visit date}) \qquad [1]$$

$$\text{First Age} = \text{Age shown in database} - \text{Gap} \qquad [2]$$

2.2. Study Design

To analyze primary care use of students with mental health disorder (MHD) in college, this study used de-identified electronic health records (EHRs) data of 21 schools participating in the College Health Surveillance Network Project[28] from January 1, 2011 through May 31, 2014 (41 month). The selected 21 schools include 660,565 enrolled students, representing all geographic regions of the United States.

Among 21 selected schools, 11 are classified as standard service system and 9 are classified as enhanced service system. Compared with a standard service system, under an enhanced service system, college counseling centers are integrated with SHCs, which means that clinicians from both centers can collaborate on patient care and Electronic Health Records (EHRs) are connected.

Table 1 summarizes descriptive information for enrolled student in twenty schools by service delivery system. One school was excluded from Table 1 because it is considered both standard and enhanced service type, which will be explained in detail in 2.4 Variables section. As shown in Table 1, the demography of enrolled students are comparable between both service systems. Since age and sex are different within the same service type, we controlled for the variance in age and sex to test the effect of service type on primary care use in the statistical analysis.

Table 1 Descriptive variables for enrolled students in sample schools, by service type

	Standard n (%) [a]	**Enhanced n (%) [a]**	**Total Sample n (%) [a]**
School Characteristics			
Number of schools [b]	11	9	20
2013 Fall Enrollment [c]	360,513 (57.47)	266,745 (42.53)	627,258 (100)
Sex			
Females	184,688 (51.23)	139,775 (52.4)	324,463 (51.73)
Males	175,825 (48.77)	126,970 (47.6)	302,795 (48.27)
Age			
Under 18	2,478 (0.69)	4,535 (1.7)	7,013 (1.12)
18-19	82,998 (23.02)	69,596 (26.09)	152,594 (24.33)
20-21	102,942 (28.55)	76,566 (28.7)	179,508 (28.62)
22-24	74,999 (20.8)	49,188 (18.44)	124,187 (19.8)
Over 24	97,088 (26.93)	66,853 (25.06)	163,941 (26.14)
Race/Ethnicity			
American Indian or Alaska Native	1,139 (0.32)	619 (0.23)	1,758 (0.28)
Asian	24,109 (6.69)	17,920 (6.72)	42,029 (6.7)
Black or African American	25,795 (7.16)	12,049 (4.52)	37,844 (6.03)
Hispanic	33,026 (9.16)	15,473 (5.8)	48,499 (7.73)
Native Hawaiian or Other Pacific Islander	483 (0.13)	225 (0.08)	708 (0.11)
White	220,125 (61.06)	169,023 (63.37)	389,148 (62.04)
Two or more races	10,117 (2.81)	7,367 (2.76)	17,484 (2.79)
Unknown	9,548 (2.65)	13,037 (4.89)	22,585 (3.6)
Nonresident alien	36,171 (10.03)	31,032 (11.63)	67,203 (10.71)

[a] Percent of enrolled students.

[b] One school excluded from this table because it underwent a significant integration process in the middle of study period; see Methods section of text.

[c] Data from IPEDS data center, enrollment data for all students, including full-time and part-time.

To demonstrate case mix equivalency, Table 2 summarizes the most frequent overall diagnostic categories[28] and the breakdown of mental health conditions according to service delivery systems. Appendix 1 details ten groups of ICD-9 codes in mental health disorder category that have been studied in this research. The prevalence of mental health conditions was substantially higher in the enhanced system compared to standard, otherwise, the frequency of all other conditions was quite similar. Since the enhanced system includes schools with counseling centers fully integrated with the health service, it is expected that higher rates of mental health conditions are seen within this service system.

Table 2 Individual patients by diagnoses and service type

	Standard n (%)	Enhanced n (%)	Total n (%)
Number of schools [a]	11	9	20
All Patients [b]	342,522 (52)	318,698 (48.2)	661,220 (100)
Preventive	189,239 (55.25)	172,683 (54.18)	361,922 (54.74)
Respiratory	145,205 (42.39)	123,635 (38.79)	268,840 (40.66)
Skin, Nails, Hair	59,752 (17.44)	50,546 (15.86)	110,298 (16.68)
Mental Health	35,407 (10.34)	59,317 (18.61)	94,724 (14.33)
Infectious Non-STI	55,918 (16.33)	48,027 (15.07)	103,945 (15.72)
Musculoskeletal	46,373 (13.54)	38,245 (12)	84,618 (12.8)
Abdominal/Digestive/Gastro	43,371 (12.66)	36,141 (11.34)	79,512 (12.03)
Injuries	45,004 (13.14)	40,161 (12.6)	85,165 (12.88)
Female Reproductive System	36,133 (10.55)	29,999 (9.41)	66,132 (10)
Urinary	32,360 (9.45)	26,673 (8.37)	59,033 (8.93)
Eye, Ear, Mouth	43,309 (12.64)	31,735 (9.96)	75,044 (11.35)
Allergies	26,341 (7.69)	19,233 (6.03)	45,574 (6.89)
Circulatory & Lymph	24,011 (7.01)	16,962 (5.32)	40,973 (6.2)
STI	20,417 (5.96)	17,478 (5.48)	37,895 (5.73)
Neurologic	12,067 (3.52)	10,036 (3.15)	22,103 (3.34)
Metabolic/Endocrine	9,883 (2.89)	5,634 (1.77)	15,517 (2.35)
Non-specific Reasons	102,627 (29.96)	105,991 (33.26)	208,618 (31.55)
Male Reproductive System	9 (<0.001)	8 (<0.001)	17 (<0.001)
Sleep problems	6,422 (1.87)	4,411 (1.38)	10,833 (1.64)
Developmental problems	381 (0.11)	967 (0.3)	1,348 (0.2)
Rehabilitation	16 (<0.001)	3,375 (1.06)	3,391 (0.51)
Mental Health Patients	35,407 (100)	59,317 (100)	94,724 (100)
Anxiety	16,641 (47)	24,419 (41.17)	41,060 (43.35)
Depression	11,731 (33.13)	19,645 (33.12)	31,376 (33.12)
Adjustment disorders	2,663 (7.52)	14,110 (23.79)	16,773 (17.71)
ADHD/ADD	5,356 (15.13)	5,932 (10)	11,288 (11.92)
Abuse of drugs	7,995 (22.58)	5,202 (8.77)	13,197 (13.93)
Eating disorders	1,587 (4.48)	4,253 (7.17)	5,840 (6.17)
Bipolar & psychotic disorders	2,141 (6.05)	3,389 (5.71)	5,530 (5.84)
Alcohol abuse	1,520 (4.29)	2,727 (4.6)	4,247 (4.48)
Personality disorders	365 (1.03)	982 (1.66)	1,347 (1.42)
Stressors	1,596 (4.51)	17,328 (29.21)	18,924 (19.98)

[a] One school excluded from this table because it underwent a significant integration process in the middle of study period; see Methods section of text.

[b] Because individuals can have more than one diagnosis over the 41 months of the study, the sum of patients in the individual diagnostic categories is greater than the number of individual patients.

2.3. Sample Population

The study population includes students, ages 15 to 50 years, with a MHD (ICD-9 codes, Appendices 1 and 2) any time before June 1, 2014, and who had at least one non-mental health visit to a student health center during one of the three study periods. The study periods are August 1, 2011 through May 31, 2012; August 1, 2012 through May 31, 2013 and August 1, 2013 through May 31, 2014. Summers (June- July) are excluded due to decreased enrollment and irregular utilization of healthcare.

Since the use of primary care by students with MHD was being explored, those without a MHD are excluded from the study. Additionally, in order to keep samples equivalent (because not all schools include counseling center data), patients who did not have at least one non-mental health contact with the health center were excluded. The resulting population includes 80,219 MH patients as our final sample. A flowchart depicting our inclusion criteria is shown in Figure 1. From the final patient population, we categorize the patients into one of two service delivery systems and calculate total primary care visit numbers (frequency), and total visit length (complexity).

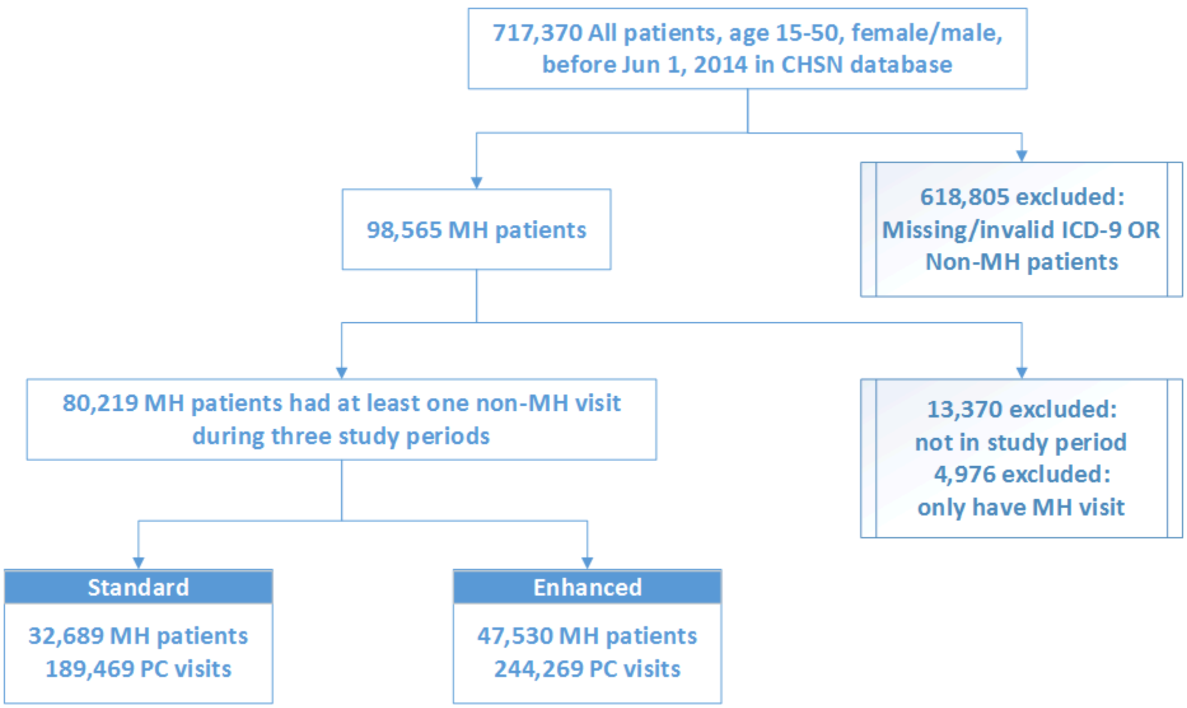

Figure 1 Study sample inclusion criteria

Table 3, which lists the descriptive characteristics of the students with MHD according to service delivery system, demonstrates that more females were seen within the enhanced system, but the age distribution is similar in both systems.

Table 3 Descriptive variables for sample population [a]

	Standard n (%)[b]	**Enhanced n (%)[b]**	**Total Sample n (%)[b]**
General			
Number of schools [c]	11.5	9.5	21
Number of patients in study period	32,689 (40.75)	47,530 (59.25)	80,219 (100)
Number of primary care visits by sample patients	189,469 (43.68)	244,269 (56.32)	433,738 (100)
Sex			
Females	18843 (57.64)	30679 (64.55)	49522 (61.73)
Males	13846 (42.36)	16851 (35.45)	30697 (38.27)
Age			
Under 18	655 (2)	1037 (2.18)	1692 (2.11)
18 to 22	19192 (58.71)	29243 (61.53)	48435 (60.38)
Over 22	12842 (39.29)	17250 (36.29)	30092 (37.51)

[a] Sample population is student that has been diagnosed with one mental health illness before Jun 1, 2014 and had at least one non-mental health visit to student health centers during at least one study period.
[b] Percent of unique patients.
[c] One school switched from standard to enhanced in the middle of study period, it is considered half standard and half enhanced in the table; see Methods section of text for detail.

2.4. Variables

- **Type of Service Delivery System**: To assess the degree of clinical and administrative integration of mental and medical health services among the CHSN schools, we used two questions from a standardized national survey[20] : extent of patient collaboration among providers and accessibility of EHR data for all providers. The medical director of each participating school completed the survey. We defined two levels of integration for clinical services. For clinical services, “standard” was the default level; the higher level was defined as follows:
  - For clinical integration, “enhanced” was characterized by accessibility of EHR data for all providers, which was invariably associated with a “fair amount” or “extensive” degree of collaboration among health and mental health service providers (n=9 of 21 schools);

  One university was treated as both standard and enhanced depending on which period of time was considered. This university underwent a significant integration process in January 2013, when it started sharing full records between counseling and medical centers and switched to an enhanced integration system. Therefore, the first period of this school is treated as a standard service type, the second period during the service transition was excluded, and the third period was included as an enhanced service type. The demographic and diagnostic data from this university is excluded from Tables 1 and 2, but included in the analyses of frequency and complexity.

- **Type of patient:** The type of patient was determined by ICD-9 code. If a mental health ICD-9 code was associated with any single date before Jun 1, 2014, the patient was classified as a mental health patient. CHSN providers used over 7,000 different ICD-9 codes. We assigned the 700 most frequently occurring codes to 21 diagnostic categories, [28] accounting for over 90% of codes occurring in CHSN. The mental health category specifically is comprised of the ten most common diagnostic groups (Appendix 1): abuse of drugs, adjustment disorders, ADHD/ADD, alcohol abuse, anxiety, bipolar and psychotic disorders, depression, eating disorders, personality disorders and psychosocial stress. This study also considered one subpopulation in students with MHD, which are students with anxiety or depression (Appendix 2).

- **Type of visit:** A patient visit was defined as any encounter with at least one valid CPT code. A primary care visit was defined as any encounter with an office or outpatient E&M code. Appendix 3 contains E&M codes used in this study. Mental health visits were defined as any encounter with an outpatient behavioral health service code and were not counted as primary care encounters. Appendix 4 contains mental health treatment CPT codes used in this study.

2.5. Outcome Measures

To analyze the utilization of primary health care resources, we measured the frequency and complexity of primary care visits. It is important to measure both metrics since fewer visits could potentially be associated with more complex encounters (i.e., longer time in the office), with no resultant savings in resources. Since many mental health disorders are associated with somatic complaints resulting in primary care visits, a difference in utilization between two service delivery systems could be a proxy for better care outcomes.

- **Frequency**: For each patient, we counted the number of visits with a primary care E&M code (Appendix 3) that occurred during the study period and calculated a visit per month factor.
- **Complexity:** For each patient, we calculated the time in minutes spent for each primary care visit that occurred during each study period, converting standard CPT codes to time equivalents (Appendix 5). Patients with no E&M codes during a visit are excluded from the complexity analysis.

2.6. Statistical Analysis

2.6.1. Hypotheses

To better understand the potential influence of the integration of behavioral and medical services on campus, we hypothesize that an enhanced service system, compared with a standard service system, will result in decreased use of Primary Care (PC) resources by students with MHD. Specifically, we tested the following two hypotheses, controlling for age, sex and number of periods in the study:

- Compared with a standard service delivery system, do patients with mental health diagnosis, who use Student Health Services for non-mental health purposes, have *fewer number of primary care visits* in an enhanced system?

- Compared with a standard service delivery system do patients with mental health diagnosis, who use Student Health Services for non-mental health purposes, *spend less time for primary care visits* in an enhanced system?

The hypotheses were tested for patients with any MHD and for the subset of patients with depression and/or anxiety (these two diagnoses comprise 62 percent of mental health conditions seen among students, in Appendix 2). The same analytical approach was used for the full sample and the subsample.

2.6.2. Statistical models

Multilevel models (also called mixed effect models), including age and sex, were developed for both frequency and complexity. For frequency, count data was analyzed (number of primary care visits) using a generalized linear multilevel model with negative binomial distribution as a link function to overcome the overdispersion problem. For complexity, total time was analyzed using a multilevel linear model with log transformation on the response variable (total visit length).

Model selection is based on likelihood ratio tests and predicted mean square error of 10-fold internal cross-validation. For the frequency analysis, the likelihood ratio test was used to determine the significance of the random effect variables, while the Wald test (F statistics) was used to test the significance of the fixed effect variable. [35] For complexity analysis, the same test for random effects was used but the Wald test (Chi-square statistics) was used for fixed effect since the transformed response variable follows a normal distribution. Finally, P values and 95% CIs were calculated for service type.

2.6.2.1. Statistical model for frequency

Table 4 and Table 5 summarize descriptive statistics for variables from sample population used for frequency analysis. In Table 4, Total_visit is the total number of primary care visits during study period, which is the dependent variable for frequency modeling. It is a count data, and its distribution is highly skewed to the left (Figure 2). Visit_per_month is total number of visits divided by the number of period in which patient appears in the study period multiply by 10 months (Equation [3]):

$$visit\_per\_month = \frac{total\_visit}{number\_of\_periods*10} \quad [3]$$

Visit_per_month variable is created to normalize total number of visit by time and will be used only in result section.

Table 4 Summary statistics for frequency modeling –dependent variable

Continuous Variable	**total_visit**	**visit_per_month** [a]
Min	1	0.033
1st Quantile	2	1.667
Median	5	0.3
Mean	6.988	0.395
3rd Quantile	9	0.5
Max	132	7.3

[a] This variable will be use later in result section.

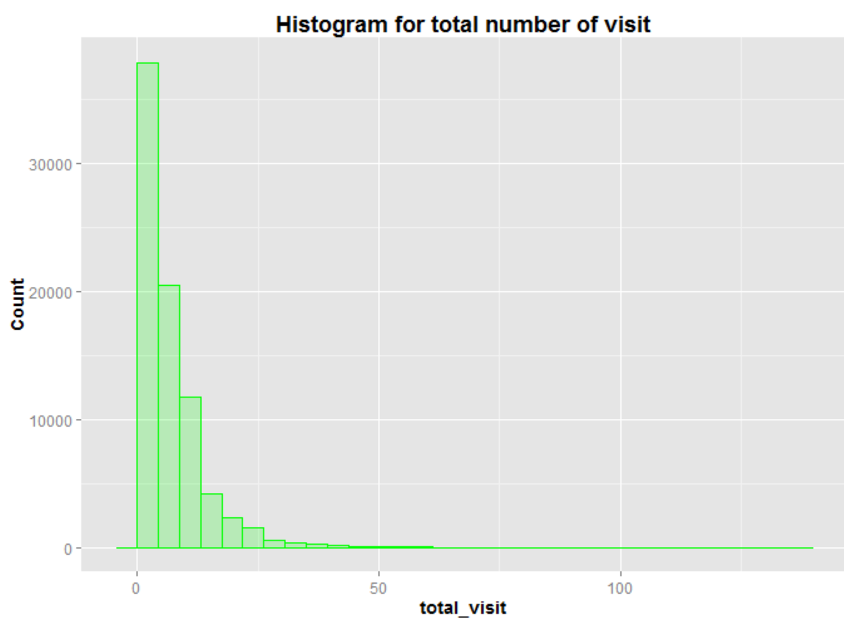

Figure 2 Histogram of total number of visits

Since both log transformation and square root transformation on count data increase bias[36], we modeled total_visit in the original scale. Both Poisson and negative binomial distributions that are commonly used to model count data, we choose negative binomial over Poisson because it overcomes the overdispersion problem in our count data. Also, the variance function of negative binomial model is more flexible than Poisson model. Figure 3 shows that negative binomial distribution fits better than Poisson distribution.

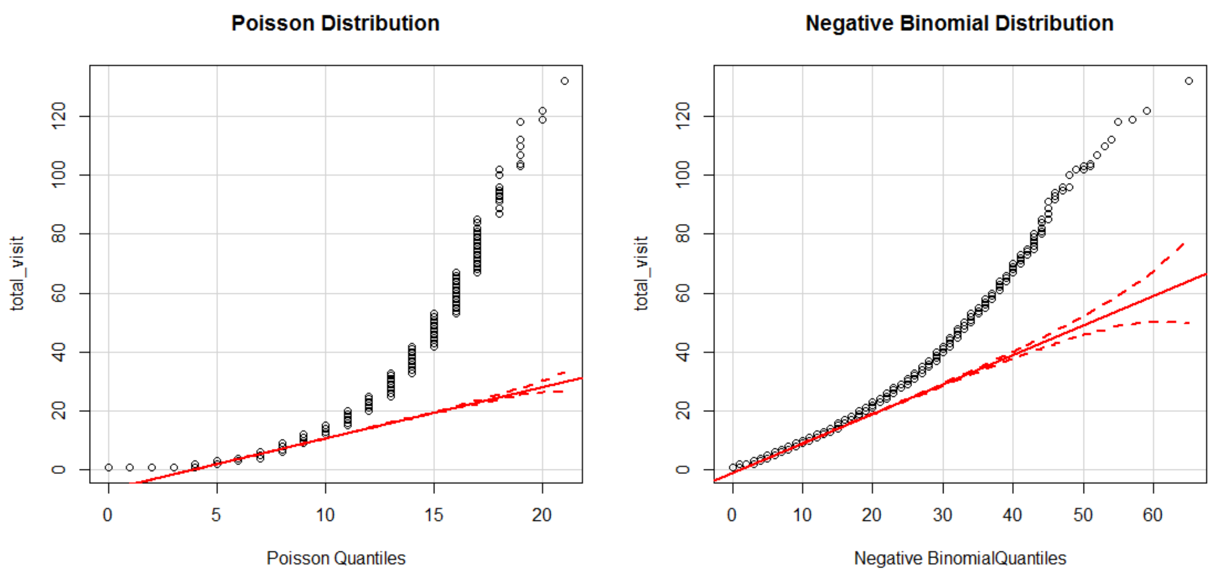

Figure 3 Quantile – Quantile plot of total_visit data against two distribution (left- Poisson, right -Negative Binomial)

Table 5 summarizes four categorical variables that are used as predictors. Service_type indicates the type of service, age, sex are explicit, while number_of_periods is the number of periods in which the patient visited SHC during the three academic periods. The variance in total_visit comes from all of the four predictor variables. Since our primary interest is in analyzing the effect of service_type on total_visit, so we set service_type as a fixed effect variable. Age, sex and number_of_periods are treated as a random sampling from a larger population, and we want to exclude the variance from these three variables while analyzing service_type. Therefore, in order to control the variance of age, sex, and number_of_periods, we model these three variables as random effects with varying intercepts. Because each patient is characterized by overlapping categories of attributes, none of the age, sex, or number_of_periods categories are subset of the other, so we use a non-nested data structure to build the multilevel model.

Table 5 Summary statistics for frequency modeling – independent variables

Categorical Variable	**Levels**
Service_type	2 levels: standard = 32689; enhanced = 47530
Age	3 levels: Under18 = 1692; between 18 and 22 = 48435; over 22 = 30092
Sex	2 levels: female = 49522; male = 30697
Number_of_periods	3 levels: one period = 36040; two periods = 28170; three periods = 16009

Therefore, the final model for frequency analysis is a generalized linear multilevel model with Negative Binomial distribution to fit the total visit number as a link function. This model can be written as Equation [4]:

$$\log(y_{i[jklm]}) = \beta_0 + \beta_1 * x_{j[i]} + \alpha_{k[i]} + \gamma_{l[i]} + \varphi_{m[i]} + \varepsilon, \qquad for\ i = 1, \dots n \quad [4]$$

where:

i: patient i, n = 80219;

y_i: total number of visits within study period; following negative binomial distribution;

x_i: type of service, with two levels for j = 1 or 2;

α_i: age category; with three levels for k = 1, 2, or 3;

γ_i: sex category; with two levels for l = 1 or 2;

φ_i: number of periods in three study periods; with three levels for m = 1, 2, or 3.

We use a multivariate multilevel negative binomial model to fit the dataset. In order to account for the uncertainty in the estimates of overdispersion, we perform Wald test (F-statistic) to test the significance of fixed effect variable. We then use likelihood ratio tests to determine the significance of random effect variables. P values and 95% confidence intervals are calculated. The same procedures are repeated for two patient groups (MH patient, AX/DP patient).

2.6.2.2. Statistical model for complexity

Table 6 and Table 7 summarize descriptive statistics for variables from the sample population used for complexity analysis. In Table 6, total_time is the total visit time for primary care visits occurred during the study period, which is the dependent variable for complexity modeling. From Figure 4 and Figure 5, the distribution of original scale data is highly skewed to the left, while after log transformation, it fits better to normal distribution. So we performed log transformation on total_time.

Time_per_period is total visit time during entire study periods divided by the number of periods in which patient appeared in three study periods (Equation [5]):

$$time\_per\_period = \frac{total\_time}{number\_of\_periods} \qquad [5]$$

This variable is created to normalize total visit time by time and will be used only in the result section.

Table 6 Summary statistics for complexity modeling –dependent variable

Continuous Variable	total_time (in minutes)	time_per_period [a]
Min	10	3.333
1st Quantile	35	25
Median	70	45
Mean	99	56.56
3rd Quantile	130	75
Max	3140	1135

[a] This variable will be use later in the result section.

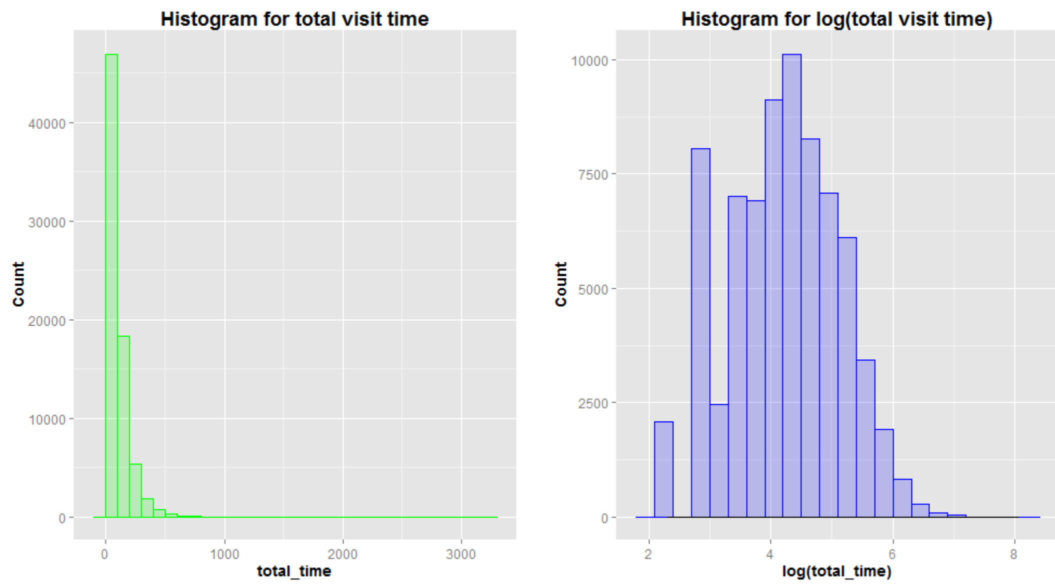

Figure 4 Histogram of total visit time in original scale and log-transformed scale

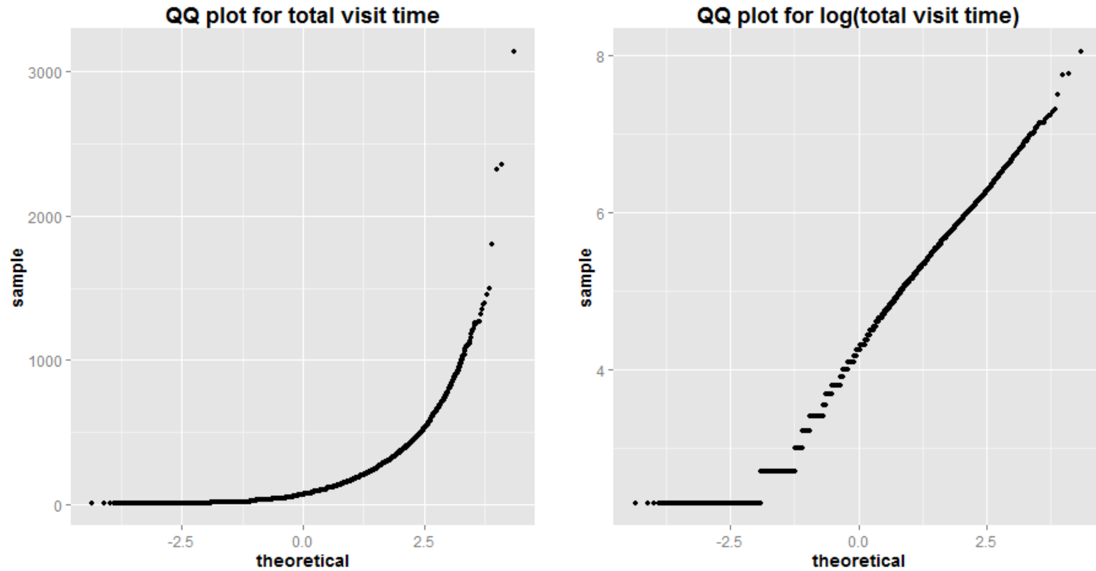

Figure 5 Quantile – Quantile plot of total visit time in original scale and log-transformed scale

In Table 7, the four categorical variables are used as predicting variables. They are defined the same way as frequency modeling (Section 2.6.2.1). The variance in total_time comes from all of the four predictor variables. Since our primary interest is in analyzing the effect of service_type on total_time, so we set service_type as a fixed effect variable. Age, sex and number_of_periods are treated as random sampling from a larger population, and we want to exclude the variance from these three variables while analyzing service_type. Therefore, in order to control for the variance of age, sex, and number_of_periods, we model these three variables as random effects with varying intercepts. Because each patient is characterized by overlapping categories of attributes, none of the age, sex, or number_of_periods categories are subset of the other, so we use a non-nested data structure to build the multilevel model.

Table 7 Summary statistics for complexity modeling – independent variables

Categorical Variable	Levels
Service_type	2 levels: standard = 31932; enhanced = 41839
Age	3 levels: Under 18 = 1588; between 18and 22 = 44708; over 22 = 27475
Sex	2 levels: female = 45889; male = 27882
Number_of_periods	3 levels: one period = 32498; two periods = 26224; three periods = 15049

Therefore, the final model for complexity analysis is a multilevel linear model with log – transformed dependent variable. The model can be written as Equation [6]:

$$\log(y_{i[jklm]}) = \beta_0 + \beta_1 * x_{j[i]} + \alpha_{k[i]} + \gamma_{l[i]} + \varphi_{m[i]} + \varepsilon, \qquad for\ i = 1, \ldots n \qquad [6]$$

where:

i: patient i, n = 73771;

y_i: total visit time in minutes within study periods; log transformed y_i follows normal distribution;

x_i: type of service, with two levels for j = 1 or 2;

α_i: age category; with three levels for k = 1, 2, or 3;

γ_i: sex category; with two levels for l =1 or 2;

φ_i: number of periods in three study periods; with three levels for m = 1, 2, or 3.

We fit a multivariate multilevel regression model to the complexity dataset, we then perform Wald test (Z-statistics) to test the significance of fixed effect variable[35]; while we choose likelihood ratio tests to determine the significance of random effect variables. P values and 95% confidence intervals are calculated. The same procedures are repeated for two patient groups (MH patient, AX/DP patient).

3 RESULT

To understand the effect of healthcare service integration, we focused our analysis on the primary care visits generated by students with MHD during the study period. Table 8 and Table 9 summarize the modeling results for the frequency and complexity models.

Table 8 Coefficients of final multilevel models

	Frequency Model			Complexity Model		
Variables	**β^b**	**St. Error**	**Exp(β)**	**β^b**	**St. Error**	**Exp(β)**
(Intercept)	1.9164***	0.2126	6.7962	4.2619***	0.3685	70.9441
Fixed Effect						
Service type						
-Standard [a]	0.146***	0.0202	1.1572	0.2060***	0.0058	1.2288
	α	**St. Error**	**Exp(α)**	**α**	**St. Error**	**Exp(α)**
Random Effect						
Age						
-Under 18	0.0293	0.0219	1.0297	0.0815	0.0580	1.0849
-18 to 22	-0.104	0.019	0.9012	-0.1094	0.0570	0.8964
-Over 22	0.0747	0.0191	1.0776	0.0279	0.0570	1.0283
Sex						
-Female	0.1268	0.0351	1.1352	0.1515	0.1381	1.1635
-Male	-0.1268	0.0352	0.8809	-0.1515	0.1381	0.8594
Number of Periods						
-One Period	-0.6127	0.0387	0.5419	-0.5974	0.1456	0.5502
-Two Periods	0.0281	0.0387	1.0285	0.0520	0.1456	1.0534
-Three Periods	0.5845	0.0389	1.7941	0.5454	0.1457	1.7253

[a] Reference category: service type = enhanced

[b] significance code: *** *P*<.001, ** *P* < .01, * *P* <.05, based on z-statistics

Table 9 Variance within groups in final multilevel models

	Frequency Model			Complexity Model		
Random Effect	**Variance**	**S.D.**	***P* value [a]**	**Variance**	**S.D.**	***P* value [a]**
Age	0.0001	0.0313	<.001	0.0098	0.0991	<.001
Sex	0.0028	0.0533	<.001	0.0459	0.2143	<.001
Number of Periods	0.0254	0.1595	<.001	0.3285	0.5732	<.001
Residual	0.1000	0.3163		0.6	0.7746	

[a] *P* value based on likelihood ration test

3.1. Frequency analysis result

There were 189,469 primary care visits by 32,689 students with MHD in the standard model schools and 244,269 primary care visits by 47,530 students with MHD in the enhanced model schools. Figure 6 shows the Pearson residual versus fitted plot for the frequency model. As we can expect, residuals are discrete because of count data. Also, some outliers exist on the left. The mean of residuals is over zero, but it is consistent across the fitted values.

The results of the negative binomial multilevel model for frequency (Table 8), controlling age, sex and number of periods, demonstrate a significant difference by service type ($F= 516.7$, $p<0.001$) across all groups. Overall, students with MHD had 15.72% (95% CI, 10.77%-20.44%) higher rates of primary care visits in college health systems with standard clinical integration compared to the enhanced integration model, regardless of age, gender and number of periods. The likelihood ratio tests show that the variance within age, sex and number of periods are each significant as well (Table 9), with males and students 18-22 years old having lower visit rates (Table 8). All of the above findings hold for the anxiety and depression diagnostic subgroup, where patients seen in the standard system have a 17.45% (95% CI, 11.79%-23.41%, $p< 0.001$) more visits than in the enhanced system regardless of age, sex and number of periods.

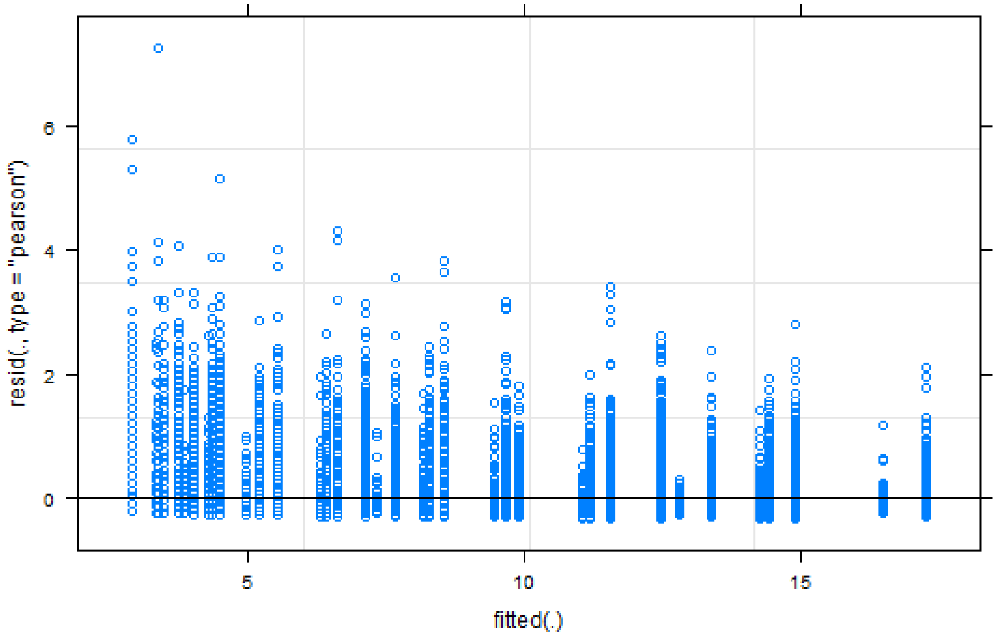

Figure 6 Diagnostic plot for negative binomial multilevel linear model for frequency

Figure 7 displays the mean monthly visit rates by age and sex with 95% confidence intervals. Table 10 shows the corresponding statistics used in Figure 7. It shows that other than the youngest patient group (under 18 group has small sample size, approximately 2% of total population), the differences in monthly visit rates are statistically significant between two service models across four patient groups. Females generate more primary care visits than males in all age groups.

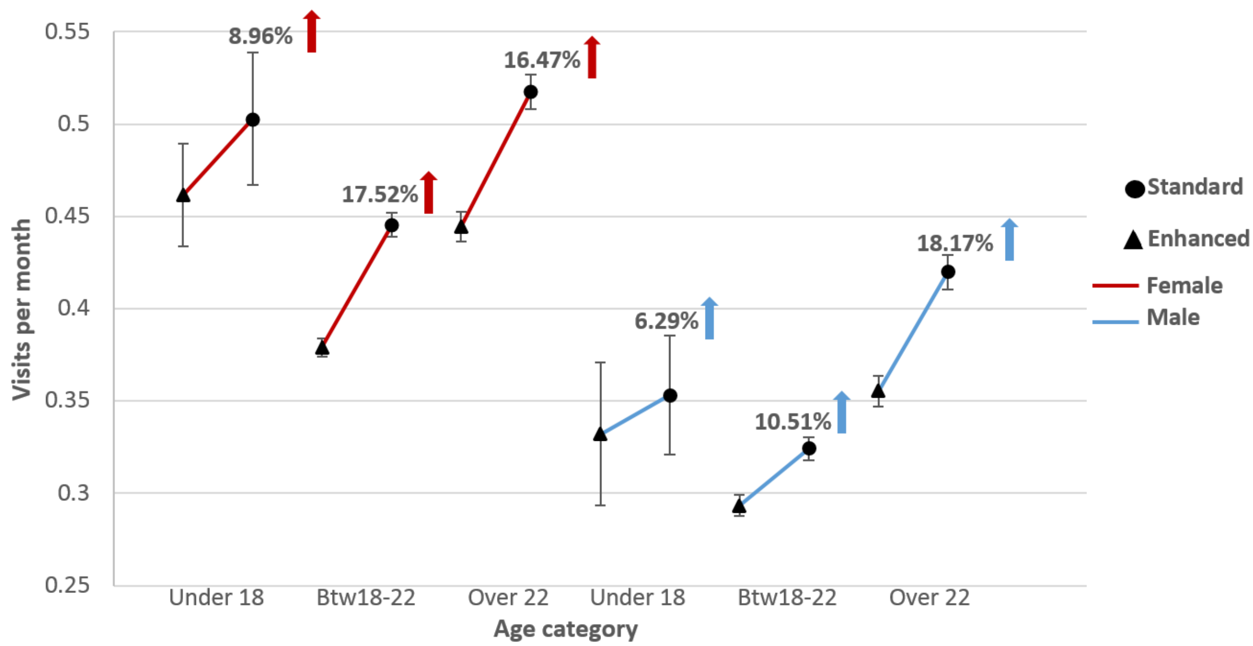

Figure 7 Mean primary care visits per month with 95% C.I.

Table 10 Mean monthly visit rate by sex and age groups

Sex	Age	Service Type	N	Mean	SD	95% C.I.	
Female	Under18	Enhanced	724	0.4615	0.3817	[0.4893,	0.4337]
Female	Under18	Standard	405	0.5028	0.3698	[0.5389,	0.4668]
Female	Btw18and22	Enhanced	19393	0.3789	0.3359	[0.3837,	0.3742]
Female	Btw18and22	Standard	11330	0.4453	0.3561	[0.4519,	0.4387]
Female	Over22	Enhanced	10562	0.4443	0.4194	[0.4523,	0.4363]
Female	Over22	Standard	7108	0.5175	0.4038	[0.5269,	0.5081]
Male	Under18	Enhanced	313	0.3321	0.3495	[0.3708,	0.2934]
Male	Under18	Standard	250	0.3530	0.2596	[0.3852,	0.3208]
Male	Btw18and22	Enhanced	9850	0.2933	0.2826	[0.2989,	0.2877]
Male	Btw18and22	Standard	7862	0.3242	0.2900	[0.3306,	0.3177]
Male	Over22	Enhanced	6688	0.3554	0.3464	[0.3637,	0.3471]
Male	Over22	Standard	5734	0.4200	0.3624	[0.4293,	0.4106]

3.2. Complexity analysis result

After excluding primary care visits with no associated time value, we analyzed 185,179 primary care visits by 31,932 mental health patients in the standard model schools and 214,289 primary care visits by 41,839 mental health patients in the enhanced model schools. Figure 8 shows the Pearson residual versus fitted plot for the complexity model. Residuals are discrete because of total_time is discrete. We observe a slight pattern in the residuals, but mean and variance of residual are around zero.

The log-transformed multilevel linear regression model in Table 8, controlling age, sex and number of periods in the study, demonstrates a significant difference in service type ($F= 1262$, $p<0.001$) across all groups. Overall, students with MHD spend 22.88% (95% CI, 21.42%-24.38%) more time for primary care visits in college health systems with standard clinical integration compared to the enhanced integration model, regardless of age, gender and number of study periods. The likelihood ratio test shows that the variances within age, sex and 224 number of study periods are each significant as well (Table 9), with males and students 18-22 years old having lower complexity (Table 8). All of the above findings hold for the anxiety and depression diagnostic subgroup, where patients seen in the standard system spent 26.37% (95% CI, 24.59%-28.17%, $p< 0.001$) more time for primary care visits than in the enhanced system regardless of age, sex and number of periods in the study.

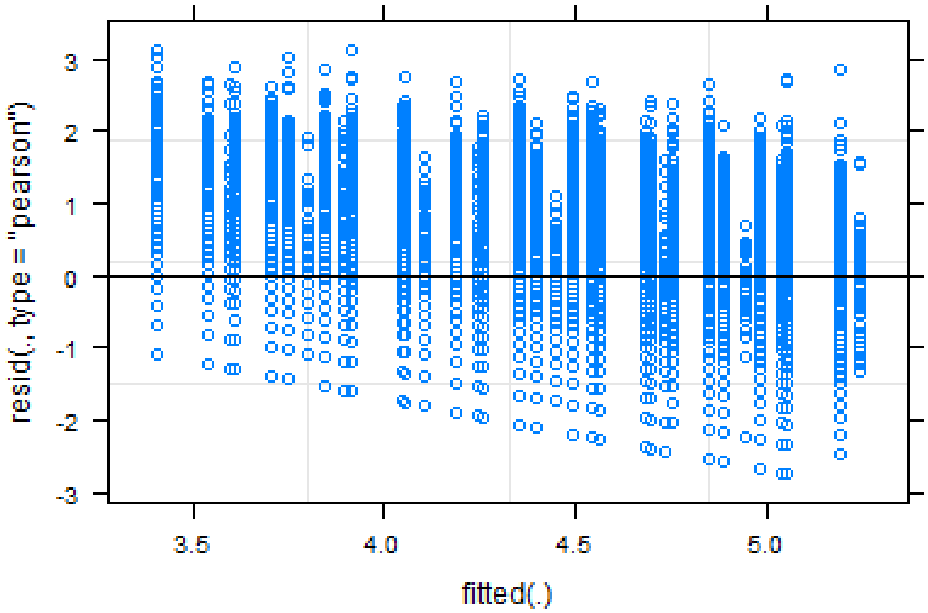

Figure 8 Diagnostic plot for log-transformed multilevel linear model for complexity

Figure 9 is the mean visit time per period by age and sex with 95% confidence interval. Table 11 shows the corresponding statistics used in Figure 9. Figure 9 and Table 11 both show that other than the youngest patient group (under 18 group, approximately 2% of total population), the difference in mean visit time per month is statistically significant between the two service models across four patient groups. Females have more complex primary care visits than males in all age groups.

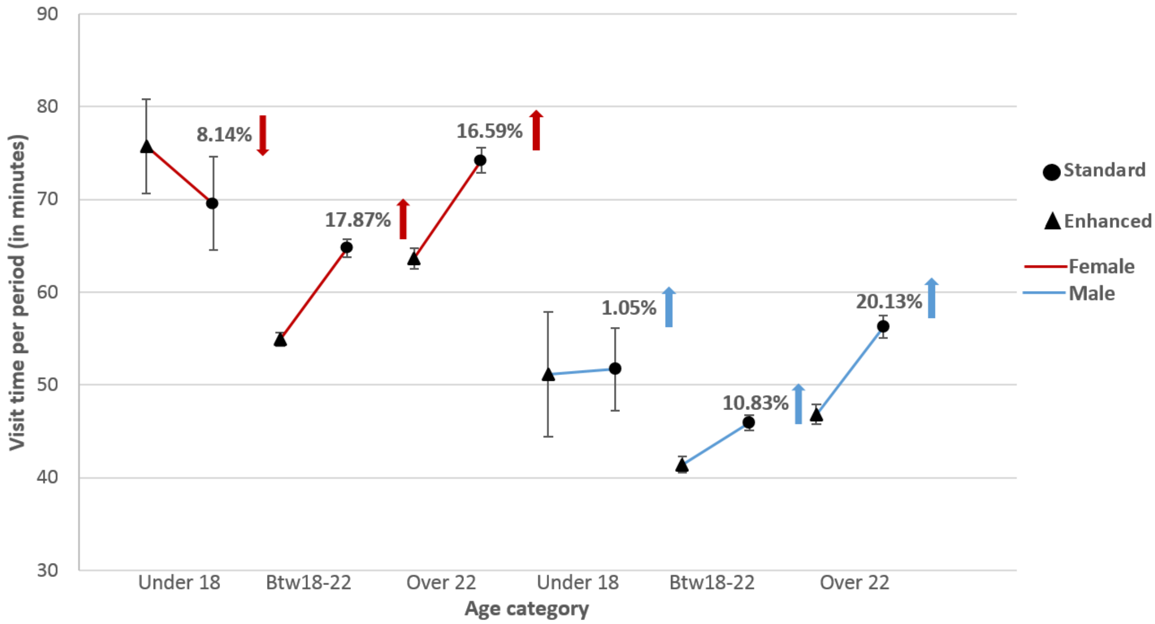

Figure 9 Mean primary care visits time per period with 95% C.I.

Table 11 Mean visit time per period by sex and age groups

Sex	Age	Service Type	N	Mean	SD	95% C.I.	
Female	Under18	Enhanced	664	75.72	66.37	[80.77,	70.67]
Female	Under18	Standard	403	69.56	51.46	[74.58,	64.54]
Female	Btw18and22	Enhanced	17439	54.93	47.92	[55.64,	54.22]
Female	Btw18and22	Standard	11120	64.75	51.96	[65.72,	63.78]
Female	Over22	Enhanced	9313	63.66	53.73	[64.75,	62.56]
Female	Over22	Standard	6950	74.21	57.73	[75.57,	72.86]
Male	Under18	Enhanced	277	51.16	57.09	[57.88,	44.44]
Male	Under18	Standard	244	51.70	35.72	[56.18,	47.22]
Male	Btw18and22	Enhanced	8523	41.41	40.46	[42.27,	40.55]
Male	Btw18and22	Standard	7626	45.90	36.32	[46.71,	45.08]
Male	Over22	Enhanced	5623	46.84	42.32	[47.94,	45.73]
Male	Over22	Standard	5589	56.26	47.22	[57.50,	55.03]

4 DISCUSSION

This study of health care utilization by college students with mental health diagnoses demonstrates significantly lower primary care utilization in an enhanced (shared EHRs and high collaboration among clinicians) clinical integration service model. Using weighted means for each demographic group, we estimate that if students who were originally cared for in the standard model had been treated in the enhanced integration model, there would have been 19,070 fewer primary care visits and 4,451 less hours in the primary care clinic during a typical ten month academic term. We conclude that accessibility of cross-disciplinary health records and the associated robust provider collaboration are the critical features that are correlated with decreased use of primary care.

There are several characteristics of enhanced clinical integration that could contribute to these findings. Clinically, a setting in which there is ongoing cross-disciplinary collaboration exposes each discipline to the others' language and ways of practice, leading to more rapid and effective bi-directional referrals, and greater ease in discussing multifaceted clinical presentations with patients. Interdisciplinary access to a comprehensive medical record supports more informed treatment decisions. Furthermore, integrated health services more frequently establish interdisciplinary teams for caring for certain categories of patients such as those struggling with eating disorders or substance abuse problems, resulting in better coordination of care and more widespread use of established treatment guidelines and protocols.[25]

Interestingly, the degree of psychological information available does not appear to impact the findings above. For example, participating universities with enhanced clinical collaboration do not necessarily share deeply personal information such as notes from psychotherapy sessions, but rather share information such as diagnoses, date, type of appointment and psychotropic medications prescribed.

From the patient/client standpoint, half of the care for identified mental health disorders in the general population is delivered in general medical settings.[37] It has also been shown repeatedly that patients seen in integrated practices are more likely to schedule and keep mental health appointments.[24] This is likely true of the collegiate population as well. Furthermore, it is reasonable to hypothesize, based on current findings, that college students engaged in psychotherapy or counseling within integrated health centers may receive more targeted and effective care, endure fewer somatic complaints and consequently seek less general medical care. Additionally, patients engaged in cross-disciplinary healthcare may have increased awareness about the relationship of physical and psychological symptoms and thus be able to manage their health care more appropriately and effectively. A common example is the student with an anxiety disorder who better understands that symptoms of shortness of breath, fatigue and dizziness are manifestations of worsening anxiety, and thus is more likely to use counseling rather than primary care.

Multidisciplinary collaborative care models have been shown to lead to lowered overall medical costs (e.g. visits and testing) through more cost-effective treatment.[38] In our study, outpatient medical visits for patients with mental health diagnoses in enhanced clinical integration models are substantially less frequent and complex. Enhanced integrative campus health systems that have meaningful interdisciplinary collaboration, shared access to basic health information, and adequately resourced health services[39] including counseling centers will result in more efficient service as well as cost savings for institutions, students, and their families.

There are a number of limitations to the present study. Since schools' participation in this network was predicated on having EHR and internal resources necessary to support the project, participating institutions do not constitute a random sample. Nonetheless, the demographics of the 21 network schools closely match the 108, four-year Carnegie Research Universities/Very High [40, 31] These findings are therefore most directly applicable to this category of institutions. Unfortunately, since a significant proportion of institutions did not include ethnicity in their EHR data, we did not have sufficient data to analyze trends among ethnic groups. For health care services with no access to behavioral health records, providers relied on identifying students with mental health diagnoses from history alone. Therefore, the number of patients with these disorders may be underestimated, or self-identified mental health patients may use primary care services at disproportionately higher rates. This study could neither address students with mental health disorders diagnosed and managed exclusively at separate counseling centers or in the private sector nor assess actual clinical outcomes of patients with mental health disorders (e.g. hospitalizations, suicidality, symptom improvement). Thus we need to be cautious in concluding that lower utilization of primary care means more success treating psychological conditions. Also, when measuring health care efficiency, one may naturally think of treatment outcome as a measure of how effective and efficiency a health care system is in patient care. Unfortunately, CHSN database does not include treatment outcome. In the meantime, it is very difficult to define treatment outcome for students with MHD since mental health problems are chronic and relapse easily. Therefore, this study use frequency and complexity as a surrogate for treatment outcomes, cost and quality to evaluate healthcare efficiency. Finally, patient and visit typologies rely on ICD-9 and CPT codes entered by providers. Though it is impossible to know precisely how providers code each visit, the similarity in the frequency and ranking of the most common conditions suggests very consistent clinician coding in both models of clinical integration (Table 2).

This study improves understanding of the potential benefits of caring for college students in enhanced clinical integration care models. Experts have called for high quality of care including seamless referrals[9] in the provision of mental health services to college students, yet nationally, just 29% of counseling centers collaborate extensively with the student health service, and only 19.9 % (6.3% psychiatry only) permit access to counseling center records without additional informed consent.[20] It is likely that in part, this is due to privacy concerns and standards in the mental health field that need to be continually accounted for both clinically and administratively. This study provides evidenced-based data that should motivate institutions to reassess their campus health care delivery systems in order to adopt a more integrated clinical service model. In conjunction with adequate resourcing of mental health services, redeploying resources to help encourage better collaboration and information sharing across disciplines should contribute to improved care with significant cost savings.

As the US health care system grapples with providing more efficient care at lower costs, more research should be done with the colleges that have established integrated care models to see if similar systems could be implemented for the general public.

5 CONCLUSION

Modeling results demonstrate that the hypotheses we proposed for this work are valid. With a large population dataset, we demonstrated that the health care utilization by college students with mental health disorders is significantly lower in an enhanced clinical integration service model. Same for the subpopulation of anxiety and. Lower visit frequency and lower complexity of primary care visit in an integrated health care system suggest that MH patient are better taken of in such a system and therefore reduce the utilization of healthcare resources. We conclude that the increased accessibility of cross-disciplinary health records and higher level of collaboration between mental and medical centers are critical to enable more efficient primary care usage. Future work includes temporal analysis on the enhanced schools to examine the utilization before and after the service integration event to test the significance of this transition and prediction of the demand of primary care resources based on student visit /diagnostic patterns.

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Appendix 1

Appendix 1 ICD-9 codes for mental health disorders

Group Name	ICD-9 Diagnosis Code
Abuse of drugs	292.89, 304.00, 304.3, 304.30, 304.8, 304.80, 305, 305.1, 305.10, 305.2, 305.20, 305.21, 305.22, 305.23, 305.30, 305.4, 305.40, 305.41, 305.42, 305.5, 305.6, 305.7, 305.8, 305.9, 305.90, V58.69, V65.42
ADHD & ADD	312.3, 312.39, 314, 314.00, 314.01, 314.1, 314.89, 314.9
Adjustment reaction disorders	309, 309.0, 309.1, 309.2, 309.21, 309.22, 309.23, 309.24, 309.27, 309.28, 309.29, 309.3, 309.4, 309.8, 309.81, 309.82, 309.83, 309.89, 309.9
Alcohol-related disorders	291, 291.0, 291.1, 291.2, 291.3, 291.4, 291.5, 291.8, 291.81, 291.82, 291.89, 291.9, 303, 303.00, 303.9, 303.90, 303.91, 303.92, 303.93, 305.0, 305.00, 305.01, 305.02, 305.03, 535.3, 790.3, 980, 980.0, E860, E860.0, V11.3
Anxiety, dissociative and somatoform disorders	293.84, 300, 300.0, 300.00, 300.01, 300.02, 300.09, 300.15, 300.20, 300.21, 300.23, 300.29, 300.3, 300.39, 300.5, 300.7, 300.9, 306.4, 307.23, 308, 308.0, 308.3, 308.9, 313.82
Bipolar & other psychotic disorders	295.7, 295.70, 296.35, 296.36, 296.4, 296.40, 296.42, 296.44, 296.45, 296.5, 296.51, 296.52, 296.55, 296.56, 296.62, 296.70, 296.8, 296.80, 296.89, 296.89, 296.9, 298.9
Depression	293.83, 296.2, 296.20, 296.21, 296.22, 296.23, 296.25, 296.26, 296.3, 296.30, 296.31, 296.32, 296.33, 296.34, 296.39, 296.90, 300.4, 311, 311, V62.84
Eating disorders	307.1, 307.10, 307.5, 307.50, 307.51, 307.59
Personality disorders	301.9, 301.13, 301.4, 301.83
Psychosocial stress	302.6, 302.60, 302.70, 302.73, 302.75, 302.85, 607.84, 995.53, 995.54, 995.83, V61.10, V61.20, V61.8, V62.2, V62.3, V62.4, V62.81, V62.82, V62.83, V62.89

Appendix 2

Appendix 2 ICD-9 codes for anxiety and depression diagnoses

ICD-9 Code	Description
293.83	Mood disorder in conditions classified elsewhere
293.84	Anxiety disorder in conditions classified elsewhere
296.2[-,0,1,2,3,5,6]	Major depressive disorder single episode
296.3[-,0,1,2,3,4,9]	Major depressive disorder recurrent episode
296.90	Unspecified episodic mood disorder
300	Anxiety, dissociative and somatoform disorders
300.0[-,0,1,2,9]	Anxiety states
300.15	Dissociative disorder or reaction unspecified
300.2[-,1,3,9]	Phobic disorders
300.3[-,9]	Obsessive-compulsive disorders
300.4	Dysthymic disorder
300.5	Neurasthenia
300.7	Hypochondriasis
300.9	Unspecified nonpsychotic mental disorder
306.4	Gastrointestinal malfunction arising from mental factors
307.23	Tourette's disorder
308[-,0,3,9]	Acute reaction to stress
311	Depressive disorder not elsewhere classified
313.82	Identity disorder of childhood or adolescence
V62.84	Suicidal ideation

Appendix 3

Appendix 3 CPT codes for primary care visit (Evaluation and Management codes)

CPT Code	Description
99201-99205	New patient
99211-99215	Returning patient
99218-99239	Hospital inpatient services
99241-99245, 99450	Consultations
99381-99387	Preventive medicine services for new patient
99391-99397	Preventive medicine services for established patient
99401-99429	Preventive medicine services for other risk reduction
99358-99360, 99371-99373, 99441-99444, 99499	No face to face services
99999	Not specify

Appendix 4

Appendix 4   CPT codes for mental health visits

CPT Code	Description
90791	Psychiatric Diagnostic Examination without medical services
90792	Psychiatric Diagnostic Examination with medical services
90801-90899	Individual/family/group/ psychotherapy, etc.
96101-96125	Psychological testing, etc.

Appendix 5

Appendix 5 CPT codes with complexity values

CPT Code	Complexity (in minutes)
99211	5
99201, 99212, 99307 , 99406, 99441	10
99211 , 99213, 99224, 99231, 99241, 99308, 99334, 99347, 99401, 99407, 99442	15
99202, 99251, 99324, 99339, 99341, 99374, 99377, 99379, 99408	20
99214, 99225, 99232, 99304, 99309, 99335, 99348, 99443	25
99242, 99203, 99221, 99238, 99315, 99325, 99340, 99342, 99366, 99367, 99368, 99375, 99378, 99380, 99402, 99409, 99411	30
99226, 99233, 99239, 99305, 99310, 99316	35
99243, 99215, 99252, 99336, 99349	40
99204, 99306, 99326, 99343, 99403, 99385, 99395	45
99222	50
99253	55
99244, 99205, 99327, 99337, 99344, 99350, 99404, 99412	60
99223	70
99228, 99345	75
99245, 99254	80
99255	110