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Running head: EFFECT OF A SBHC ON ACCESS TO CARE

DNP Final Project Report

The Effect of a School-Based Health Center on Access to Care in a Rural Community

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University of Kentucky

College of Nursing

Fall, 2018

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Abstract

BACKGROUND: Lack of access to healthcare is a nationwide issue that affects underserved, minority, and rural populations. School-Based Health Centers (SBHCs) is one way to help increase access to care for students, staff, and family members.

PURPOSE: The purpose of this project was to provide preliminary data on the impact of a SBHC in a rural Kentucky community on access to care and school attendance.

METHODS: A univariate descriptive analysis was conducted to evaluate the perceived impact of the SBHC on access to care and demographic factors. Data was analyzed using Pearson's Product Moment Correlation, two-sample t-tests, and The Wilcoxon Signed Rank Test. A survey was conducted along with examination of published attendance rates.

RESULTS: There was a significant and positive relationship between the patient's perceived impact on access total score and overall access to care with the use of the SBHC ($p < .001$). All subjects perceived the SBHC to increase access to care for sick visits. ED use significantly decreased after implementation of the SBHC ($p < .001$). Those who never used the ED perceived an increase to access to care post SBHC implementation ($p = .023$). Attendance rates improved for students in grades 2nd, 5th, 6th, 8th, 10th, and 11th, and only teachers from the high school.

CONCLUSION: SBHCs are a needed resource for rural communities to help increase access to care. However, their existence cannot be sustained without adequate financial support.

Therefore, SBHCs must take part in the reporting of standardized measures through the SBHC Alliance National Quality Initiative to gain state and national support.

The Effect of a School-Based Health Center on Access to Care in a Rural Community

Introduction

Access to a primary care provider is crucial to the health and well-being of all individuals. A consistent patient-provider relationship has been associated with better health outcomes, decreased mortality and lower healthcare costs (U.S. Department of Health and Human Services, 2018). However, many, to this day, still do not have access to healthcare, much less a usual primary care provider. One group that has been identified as needing better access are rural school-age children (Schwartz et al., 2016). The purpose of this project was to provide preliminary data on the impact of a school-based health center (SBHC) on improving access to primary care in a rural Kentucky community.

Background

Access to healthcare is multifaceted. The World Health Organization (WHO) defines access to care through three dimensions: physical accessibility, financial affordability, and acceptability (Evans, Hsu, & Boerma, 2013). Therefore, health services should be within reasonable reach when needed, have flexible appointment scheduling and extended hours of operation. Further, access involves being able to receive care without financial hardship. Lastly, to avoid discouraging patients from seeking out health services, access must meet the patients' social and cultural needs (Evans, Hsu, & Boerma, 2013).

Lack of access to healthcare is a nationwide issue. However, access disproportionately affects underserved, minority, and rural populations (Schwartz et al., 2016). The lack of access can be directly related to increased morbidity and mortality, emergency department (ED) use, and hospital admissions (Knopf et al., 2016). In the rural state of Kentucky, 23.3% of adults did not have a usual source of care as of 2014, which is critically above the national average of

17.3% (Black & Schiller, 2016). Likewise, approximately 29% of pediatric patients living in Kentucky are experiencing the same access issues (Bloom, Jones, & Freeman, 2013). There must be dedicated strategies to help combat this issue.

Solutions to overcome the lack of access to primary care have been trialed. They range from increasing the number of primary care providers to expanding health insurance coverage through the establishment of the Affordable Care Act in 2010 (Kominski, Nonzee, & Sorensen, 2017). While these solutions may be useful in time, they are not immediate. Establishing access within school systems is one solution that would positively impact access. Moving existing primary care resources directly in schools effectively increases access to care for students and school staff.

Based on the National Assembly on School-Based Health Care, SBHCs “are partnerships created by schools and community health organizations to provide on-site medical and mental health services that promote the health and educational success of school-age children and adolescents” (2002, para. 1). SBHCs offer an array of services including treatment and maintenance of acute and chronic health conditions, well checks, and preventative visits including administration of immunizations (Knopf et al., 2016). Some SBHCs even offer dental, vision, and mental health care (Knopf et al., 2016). For some SBHCs only students are provided access, while others extend services to school employees and family members to offer care to a more diverse population.

School-Based Health Center Census

The first ever SBHC was opened in 1967 in Cambridge, Massachusetts (Porter, Avery, & Fellows, 1974). This clinic was established due to the insufficient number of practicing physicians in this large urban area. It was thought that access to primary care contributed to a rise

in the number of outpatient hospital visits and emergency department use (Porter, Avery, & Fellows, 1974). Therefore, the Department of Pediatrics at Cambridge Hospital teamed up with local health departments to start placing pediatric nurse practitioners within district schools (Porter, Avery, & Fellows, 1974). Since the late 1960's, SBHCs have rapidly dispersed across the nation.

National SBHC Census

The National School-Based Health Alliance is a national organization that conducts census on SBHCs. The latest data, completed for the year 2013-2014, revealed that there were 2,315 SBHCs within the United States. This number grew 20% from the previous 2010-2011 census. The majority of SBHCs (51.2%) are located in urban communities. Whereas, 34.6% are located in rural areas and 14.2% in suburban communities. However, the largest growth was seen in rural communities accounting for 60% of the newly established SBHCs in the 2013-2014 census.

Federal funding supports over half of all SBHCs across the nation through programs such as the U.S. Department of Health and Human Services Office of Population Affairs, and the Health Resources and Services Administrations (HRSA) (Heller, 2017). Between 2010 through 2013, the HRSA funded \$200 million to over 500 SBHCs throughout 47 states (Heller, 2017). Other funding sources come from Medicaid (14%) and the remaining 6% from outsourced funding such as the tobacco settlement (School-Based Health Alliance, 2014).

State SBHC Census

Currently, 49 states have implemented SBHCs. The number of state SBHCs range from none in North Dakota to 273 in New York, with many states falling somewhere in between

(School-Based Health Alliance, 2014). In the state of Kentucky there are currently 93 SBHCs (School-Based Health Alliance, 2014).

Even with the substantial growth in federal funding and support for SBHCs, the financial support from individual states is declining. As of 2014, only 18 states have adopted policies to support SBHCs. Kentucky does not receive federal monies and relies on funding from private payers such as the implementing healthcare organization itself (School-Based Health Alliance, 2014).

Local SBHC Census

A rural school-based health clinic was established in Scottsville, Kentucky in January of 2018 by a commonwealth health corporation, The Medical Center. This clinic provides complimentary primary care to the students and staff of the school district. School district employees whose family members are covered under their school insurance are also allowed to utilize the clinic's services.

The clinic serves all schools within the school district including the primary, intermediate, middle, and high schools. However, the clinic is physically located within the high school. All schools are located on one campus. However, when a student at the primary, intermediate, or middle schools needs to be seen, they are usually picked up and brought to the clinic by their parent/guardian. Occasionally, these students are taken to the clinic by school personnel with approval of the parent/guardian. The SBHC is currently open half days on Monday, Tuesday, Thursday and Friday and follows the school calendar regarding holidays and school breaks.

Currently, the clinic is staffed with one Family Nurse Practitioner (FNP), one Licensed Practical Nurse, and a medical receptionist. When the clinic is closed and not offering services,

patients are directed to receive care at one of the other Medical Center primary care clinics, or the patients' established primary care provider. The nurse practitioner serving the SBHC is a primary care provider (PCP) in the community at one of the Medical Center clinics. Therefore, she is an established PCP for many of the SBHCs' patients. When she is unavailable at the SBHC due to the school hours, she may still provide care but at a different location.

If a patient's established PCP is affiliated with the Medical Center, but the patient receives care at the SBHC, their established PCP will have access to the care that was provided through the electronic medical record. However, those who have established PCPs outside of a Medical Center organization can simply sign a release of information. Then, the care provided can be transferred to their established PCP. The patient's provider can be contacted byways such as phone call, fax, mail, or paper copy of the patients' chart. This will help ensure continuum of care with patient's utilizing the new clinic.

Since implementation in January 2018, the SBHC is providing care to more patients than what was expected when the clinic was established. The clinic currently sees around 10-20 patients during their half day, however, this number is minimal compared to what the clinic could be seeing. The involved school district staffs around 1,000 employees, plus, nearly 3,000 students are enrolled. Thus, if the clinic was able to be open full days, and staff more providers, then a greater population may be reached.

The exact impact the SBHC has on this rural community has yet to be determined. The clinic strives to provide convenient healthcare in a timely manner, with the anticipation that those seen for minor issues can return to school/work to help decrease school absences. Therefore, a study to reveal the impact this clinic has had on access to healthcare within this rural community and attendance rates is needed.

Literature Review

A literature review on the effect SBHCs have on overall health, access to care, and academic performance was completed. PubMed was searched using the key terms “School-Based Health Centers,” and “Access to Care,” “Education,” and “Impact.” Only those articles completed within the last five years were included. The review provided evidence to support SBHCs as a way to improve access and quality of primary care.

SBHC Benefits

Academic performance is noted as one benefit of SBHCs. Knopf et al. (2016) completed a systematic review of 46 studies that revealed the following information. Students who utilize a SBHC have an increase in their GPA and continual grade promotion. There is also a decrease in school suspension and drop-out rates (Knopf et al., 2016). Outside of school benefits, Knopf et al. (2016) also examined the effect of low-income communities on children’s health.

Children from low-income communities have worse health status, miss more days of school due to illnesses, and are more likely to not have a usual place to receive healthcare when compared to their counterparts (Knopf et al., 2016). Due to this finding, a recommendation from The Community Preventive Services Task Force (CPSTF) is for SBHCs to be incorporated within low-income communities. The CPSTF believes SBHCs will provide a long-term benefit of improving educational and health outcomes for these students (2016).

Improvement in overall health status was associated with the use of SBHCs (Knopf et al., 2016). This was linked to an increase in vaccination rates, preventative screenings, and contraceptive use, along with a decrease in emergency department use and hospital admissions (Community Preventive Services Task Force, 2016; Knopf et al., 2016). All of these findings were found to be even more beneficial for the minority adolescents living in underserved

communities who uses a SBHC (Lee, DeFrank, Gaipa, & Arden, 2017; O’Leary et al., 2014; Parasuraman, & Shi, 2015).

SBHCs have demonstrated improved access to primary care that is met with high satisfaction from parents and children. Albright (2016) evaluated adolescents and parents perspective on SBHCs. The adolescent patients revealed they preferred to be seen at a SBHC versus a primary care clinic. They felt their care was better coordinated and more compassionate. Parents perceived the SBHCs to be more accessible than traditional primary care clinics (Albright, 2018).

Validation between studies within the literature review revealed the outstanding potential SBHCs have to improve mental health illnesses (Lai et al., 2016; Larson, Chapman, Spetz, & Brindis, 2017; Paschall, & Bersamin, 2018; Ran, Chattopadhyay, & Hahn, 2016). Paschall and Bersamin (2018) report that students who attended a combined primary care with mental health clinic were less likely to report suicidal ideation, suicide attempts, or drug use. A study completed by Larson, Chapman, Spetz, and Brindis (2017) supports SBHCs ability to treat and reduce mental health illnesses within the populations they serve.

SBHCs also have financial benefits that outweigh their operating costs (Ran, Chattopadhyay, & Hahn, 2016). This was an interesting finding as clinic financing is an issue for most SBHCs. One of these benefits being providing a net savings to Medicaid patients who use SBHCs. This was related to averting healthcare costs through ways such as productivity lost, travel costs, reduced emergency department use, and decrease referrals (Ran, Chattopadhyay, & Hahn, 2016). SBHCs also were found to help decrease parental work absenteeism and student school absenteeism (Ran, Chattopadhyay, & Hahn, 2016; Riley, Laurie, Pleque, & Richarson,

2016). Thus, improvements in Medicaid savings and decreasing time off work and school can both offer financial gain to the communities and the citizens where SBHCs reside.

SBHC Barriers

The benefits of SBHCs though well recognized have not been widely adopted in all school communities. Financing, billing, and reimbursement issues are major challenges to the initiation and sustainability (Community Preventive Services Task Force, 2016). From community to community, SBHCs are funded differently.

There are four main sources of financial support for SBHCs. Patient revenue, including Medicaid, CHIP, private insurance, or self-pay, is one financial source that covers the cost for billable expenses within SBHCs (School-Based Health Alliance, 2018). For those expenses that are not billable to patients, the remaining three funding agencies are left to pick up the cost. This includes partner contributors, private sectors, or government grants. Partner contributors can include surrounding hospitals, the community, or the school. Private sectors are less common but include donating foundations and corporations. These two funding sources do not guarantee monies, thus, government grants help to cover the services not reimbursable in SBHCs. However, due to lack of dedicated funds from most states, this funding source is lacking (School-Based Health Alliance, 2018). This has caused a financial barrier for most SBHCs.

Only 18 states have funds directed specifically for SBHCs, and only 13 of these states have enacted meaningful Medicaid policies that regulate reimbursement of SBHC services for Medicaid patients (School-Based Health Alliance, 2014). These policies not only regulate Medicaid reimbursement, but also collect performance data, requires certification of clinics, and monitors standards (School-Based Health Alliance, 2014). Those SBHCs within these 18 states who have endorsed SBHC policies have been more successful in reporting of performance

measures. These measures include BMI assessment, well child visits, immunizations, and mental health screenings (School-Based Health Alliance, 2018). Kentucky, and the remaining 31 states, do not have the financial source of government grants and thus, SBHCs trying to establish in these states face a financial barrier.

In 2014, the SBHC Alliance adopted the first ever set of standardized performance measures titled the SBHC National Quality Initiative (Love, 2017). The objective of this initiative was to create a platform for reporting of the quality of care being delivered through SBHCs across the nation. This framework was created to align with the national child quality measures. The overall goal was to set standards for SBHCs and collect data to compare SBHCs at the local, state, and national levels. Revealing the overall improvement in quality of care at the national level will, in hopes, lead to an increase in national support and federal funds directed towards the sustainability of SBHCs (Love, 2017).

As of 2016, only 300 SBHCs out of 2,315 had begun reporting quality measures with the SBHC National Quality Initiative (Love, 2017). Until more SBHCs begin reporting at the national level, the financial barriers will remain. As long as financial barriers remain, enacting state, local, and national policies along with SBHCs existence will remain limited. It is critical for every SBHC to demonstrate their effectiveness at the national level and take part in overcoming these barriers.

Theoretical Framework

When barriers arise in healthcare, conceptual and theoretical frameworks are effective tools to help break down these barriers. Theoretical frameworks are used to help create a systematic approach to a problem (U.S. Department of Health & Human Services: National Institutes of Health, 2005). Within the framework is not the answer to a problem, but instead, a

multistep approach to be able to link variables, predict events, or illustrate relationships (U.S. Department of Health & Human Services: National Institutes of Health, 2005). Linking theory with healthcare helps produce more effective change.

Social Ecological Model

Kentucky has a current barrier to the implementation and sustainability of SBHCs due to the lack of state policy. The Social Ecological Model is a framework that may help communities to understand factors involved with issues. It offers guidance to overcome barriers in order to create successful initiatives within social environments (Sallis, Owen, & Fisher, 2008). The overall goal of this model is to create a community that is conducive to change (Sallis, Owen, & Fisher, 2008). Thus, applying this model would be appropriate to help produce change and create a SBHC policy in the state of Kentucky.

Sallis, Owen, and Fisher (2008) reveal the benefits and uses of the Social Ecological Model. Within the Social Ecological Model are five levels of influence that help to precipitate change. The theory revolves around the way behaviors are shape by the social environment in which these levels take place. In ascending order the levels start with the individual, include the interpersonal/social network, the organizational environment, and the community, and ends with public policy (Sallis, Owen, & Fisher, 2008). All of these levels will come into play when trying to establish policy at the state level for SBHCs.

The beginning stages of the Social Ecological Model can be seen through the development and implementation of the SBHC clinic. An individual nurse practitioner initiated discussion on ways to expand her current rural health clinic into the community school system. This, represents the first level of this model.

Level two and three involve the social network and organizational environment. In creating the SBHC, the nurse practitioner used social networking to learn more about surrounding SBHCs. From this step, leadership within the organized commonwealth health corporation, The Medical Center, was approached. The corporation subsequently reached out to the community and requested partnership with the school system to implement the SBHC. The last level, public policy, has yet to be accomplished. In hopes to grow to reach this level, the clinic is requesting evidence of the impact the clinic has had on the rural community. Thus, leading to the importance of this study.

Purpose

Objectives

The overall goal of this project was to provide preliminary data on the impact the SBHC has on primary care access within a rural community in Kentucky. The primary focus was to demonstrate the patient-perceived impact of the SBHC on improving access to care. A secondary focus was to determine the effect the SBHC has on school attendance and overall patient satisfaction with care rendered.

Project Aims

The specific aims of this project are as follow:

Aim 1: Assess the perceived impact of those who utilize the SBHC (school staff, family members, and guardians of the student patients) on access to care and patient satisfaction.

Aim 2: Compare overall school attendance rates to those of the students and teachers who utilize the SBHC.

Aim 3: Examine demographic factors among the students, staff and family members who utilize the SBHC including gender, age, race, grade level (for students) / employment

status (for staff), number of SBHC visits, the reason for visits, type of insurance, and ER use.

Methods

Setting

This project evaluation study took place at a SBHC in a rural Kentucky community. The clinic is managed by a local commonwealth health corporation. Current employees include one FNP, one Licensed Practical Nurse, and a medical receptionist. The clinic serves between 10-20 patients per day and provides an array of services including preventative, acute, and chronic care. Additional services such as mental healthcare and dental services are not included in this clinic.

Study Population

The study population included all patients who received care at the clinic during the study period. This included students, school employees, and family members who attended the clinic January 1st, 2018 to September 31st, 2018. The study population was identified by the clinic manager who was able to generate a list of who attended the clinic during the study time frame. A total of 450 clinic patients were identified as users in the designated study period. Duplicate visits from the same patient were excluded.

In order to evaluate the effectiveness of the SBHC in reducing absenteeism, all students and teachers of the school within the study period were added to the study population. Attendance rates are collected by the school district and percentages are disclosed as public information. An overall attendance list was generated by the Assistant Superintendent of Operations to include a list of teacher and student attendance rates for the dates of the study period. The student attendance rates were then broken down by grade and the teacher attendance rates were broke down by school. Summer months were excluded as school is not in session. The

months of August and September were also excluded as this was a new school year and data would not be comparable to the previous months due to students changing grades.

Study Design

The study design received approval from UK IRB, The Medical Center Healthcare Organization, and the involved school district. A twenty question survey was developed to determine the perceived impact the SBHC has on access to care, patient satisfaction, and patient demographics. Patient demographics included questions regarding patient gender, age, race, grade/employment status and type of insurance. The patient's use of the clinic was surveyed and included number of times they had used the clinic along with the reasoning for their visit. Questions regarding the patients' access of primary care services and use of emergency department services prior to and after implementation of the clinic were included. The perceived impact of the SBHC on access to care and their satisfaction was surveyed using a five-point Likert Scale that ranged from strongly agree to strongly disagree. The developed survey and all of the questions can be found in Appendix B.

This study was a univariate descriptive analysis to evaluate the perceived impact of the SBHC on access to care and demographic factors. Data was summarized descriptively using means and standard deviations or frequency distributions. An access total score was created by adding together the 6-items that assessed the individuals perceived impact of access to care. Questions 12 to 17 (see Appendix B) from the survey were used. These items were reverse-scored so that a higher score for the total of the 6-items indicated a greater perception of access. The possible score then ranged from strongly disagree to strongly agree.

A single item that measured the patient's perceived impact regarding overall access to care (see Appendix B: question 18) was reverse-scored. A higher score was indicative of greater

perception of access. Pearson's Product Moment Correlation was used to assess the association between the combined six item total access score and overall access to care (single item). Comparisons of total access score between two subgroups (e.g., those who ever used the ED for care versus those who did not) was accomplished using two-sample t-tests. The Wilcoxon Signed Rank Test was used to evaluate whether there was a change in frequency of ED use between pre and post SBHC implementation. ED use was scored on a five-point scale that ranged from never to always.

Research Procedures & Data Collection

Research procedures for obtaining information on patient demographics and access to care included collecting data through the developed survey. Those who met the inclusion criteria and were over 18 years, were mailed a survey. For those subjects under the age of 18, the survey was mailed and addressed to the guardian of the child. Within the mailed envelope was a return envelope addressed to the school office and included postage. The 450 surveys were mailed on September 21st, 2018, with a return date of October 31st, 2018.

A cover page (see Appendix A) was attached to all surveys that served to inform the patient or guardian about the study and that participation was voluntary. In the cover letter, risks and benefits of participation were outlined. If the subject chose to mail the completed survey back, this was considered voluntary consent. Privacy for all subjects was ensured as no names or identification of the subjects was included.

Data collection for attendance rates included receiving the generated lists from the Assistant Superintendent of Operations from the involved school. Research procedures involved analyzing and comparing the attendance list of those seen at the clinic versus the overall attendance rates. This was completed for both students and teachers.

Results

The 450 subjects that were involved within this study included all students, staff, and family members who utilized the SBHC. However, the primary SBHC participants are high school students and high school teachers. This is to be expected with the SBHC being physically located within the high school. Another population worth noting that participates in the SBHC is retired school employees. The PCP within the SBHC is the established PCP for many retired school employees. Thus, with their past employment within the school district, many prefer to receive care at this SBHC. Returned surveys were received from 29% (n=129) of the SBHC patients.

Sample Characteristics

Sample characteristics, including gender, age, and race, can be seen in Appendix C. Of those who returned the survey, 62% (n=80) were female with the mean age being 44. There was no relationship between perceived total access scores and age or gender of the patient. Race was predominately white (98%; n=127).

Grade/employment status of subjects can be seen in Appendix D. When comparing grade/employment status of subjects, 27% (n=34) were in 9th-12th grades and 36% (n=45) were full-time employees. However, 25% (n=32) of subjects were from the category “other” and most likely given the higher age of subjects, are retired school employees. The remaining 12% were from grades K-8th (7%; n=9) or part-time employees (5%; n=6).

Number of clinic visits can be seen in Appendix E. Participants reported using the clinic one to over fifteen times. Most (84%; n=108) visited the clinic 1-4 times. The primary reasons for visiting the SBHC can be seen in Appendix F. The most common reason 68% (n=86) of subjects went to the SBHC was for acute/sick visits.

Type of insurance for subjects can be seen in Appendix G. The majority of subjects (59%; n=73) were insured by private insurance. This is to be expected with school personnel being covered under the school insurance.

Emergency Department Use Prior to and After SBHC

There was a statistically significant decrease in the frequency of using the ED for care following initiation of the SBHC based on the Wilcoxon Signed Rank Test ($t=4.2$; $p<.001$). The patient's perceived impact on access to care was compared to their ED use. Those who reported never using the ED had a significantly higher access total score compared to those who sometimes or rarely used the ED based on the two-sample t-test ($t=2.3$; $p= .023$).

Access to Care

Access to care, as determined on the survey questions, was evaluated using a 5-point Likert Scale that ranged from strongly agree to strongly disagree. The perceived impact of the SBHC on access to care can be seen in Appendix H. All subjects (n=129) reported they either strongly agree (66%; n=85), or agree (34%; n=44), the SBHC increases access to care for acute/sick visits. Regarding the SBHC increasing access to healthcare overall, 60% (n=75) of subjects strongly agree, 37% (n=46) agree, and 3% (n=5) had neutral opinions.

The access total score was compared to the overall perception of access. These two measures of access were highly correlated with each other ($r = 0.79$; $p<.001$). Pearson's Product Moment Correlation was used.

Patient Satisfaction

Patient satisfaction and reporting on the benefits of additional SBHC services can be seen in Appendix I. The clinic was rated with high satisfaction and most reported they would benefit from the SBHC offering additional resources. This includes more providers, more locations,

more hours of operations, and more specialty services such as mental healthcare. One anonymous subject wrote, “This is a great service to our community. It allows healthcare to my child, keeps her at school and me at work. I believe an increase in hours and better access for the other schools is greatly needed.”

Attendance Rates

Information regarding student attendance rates can be seen in Appendix J. Improvement in attendance rates for the students who attended the clinic was noted in grades 2nd, 5th, 6th, 8th, 10th, and 11th. Information on teacher attendance rates can be seen in Appendix K. A slight improvement in attendance was seen for those high school teachers seen in the clinic.

Discussion

The overall goal of this study was to provide preliminary data on the impact the SBHC has on primary care access within a rural community in Kentucky. With the results, we can see that access to care was perceived to be improved with the establishment of this SBHC. These results agree with what has been reported in the literature. The use of SBHCs to increase access to healthcare is supported for those underserved and rural populations (CPSTF, 2016; Knopf et al., 2016; Heller, 2017).

A significant finding within the study was a perceived decrease in ED use post SBHC implementation. A recent systematic literature review by Uscher-Pines, Pines, Kellermann, Gillen, and Mehrotra (2013) revealed that on average, 37% of ED visits are for non-urgent needs. However, this number can range to a high of 62% of ED visits (Uscher-Pines, Pines, Kellermann, Gillen, & Mehrotra, 2013). The findings in this study, along with other studies (Community Preventive Services Task Force, 2016; Knopf et al., 2016; Ran, Chattopadhyay, &

Hahn, 2016) support the use of SBHCs to help decrease the number of non-urgent visits to the ED. Thereby, reserving the ED for more emergent needs.

A secondary focus of this project was to determine the effect the SBHC has on school attendance. The grades that were noticed to have an improvement in attendance rates had a higher number of student participations in the SBHC. Likewise, the same was seen when comparing teacher attendance rates. SBHCs have been shown to improve attendance rates (Knopf et al., 2016; Rogers et al., 2016). Furthermore, attendance rates have been directly correlated to the improvement in academic performance (Lukkarinen, Koivukangas, & Seppala, 2016). Thereby, SBHCs have the ability to play a role in both of these aspects.

Within this school district, an improvement in school attendance rates has already been seen within seven months. However, the clinic is only open part time, only staffing one provider, and thus, missing out on providing care to a large number of staff and students within the school district. If the services at this clinic were able to increase, an even bigger impact may be seen in the overall school attendance and academic performance.

Implications for Future Practice

Multiple benefits of SBHCs have been revealed. However, for this rural community to reap all potential benefits from this SBHC, the clinic must expand the services offered. Of those surveyed, 87% (n=110) reported strongly agreeing, or agreeing, that they would benefit from the SBHC increasing services. Increase in services should include extending the hours to encompass full time, extending locations to reach more students and staff, as well as adding specialty services. A specialty service that the patients and community would benefit from would be mental health.

There is a critical need for mental healthcare across the nation. From 1999-2016, there has been an increase in nation-wide suicide rates by 25%. During this time frame, Kentucky has had an increase in suicide rates by 37% (CDC, 2016). Paschall and Bersamin (2018) discovered that students who attended a combined primary care with mental health SBHC were less likely to report suicidal ideation, suicide attempts, or drug use. Thereby, revealing the benefits this SBHC could attain if able to combine the primary care services with mental health. Increasing these services would not only impact the SBHC patients, but also the school district and community altogether.

Limitations

There were limitations to this study. One of those being that the study was conducted in one clinical setting and community. Furthermore, the sample size was 29% (n=129) of the SBHC participants. Therefore, the results may not be generalized to other settings. It is also important to keep in mind that multiple factors can play a role in school attendance rates outside of the use of the SBHC. Another limitation was not having access to patient's charts. Accessing patient charts who utilize the SBHC would have given additional information that may have revealed other benefits of this SBHC.

Future Recommendations

Clinical Practice

Despite the profound benefits of SBHCs that have been revealed in this study, as well as past research, limitations to their widespread use still remain. Regardless of the overall effectiveness of SBHCs, their existence cannot be sustained without adequate financial support. Therefore, future recommendations for SBHCs set forth by the SBHC Alliance is to take part in the reporting of standardized measures through the SBHC National Quality Initiative.

Five core performance measures are currently being asked to be reported on through the SBHC National Quality Initiative. These five measures include annual well child visits, annual risk assessments, BMI screening and nutritional counseling/physical activity screening, depression screening, and chlamydia screening (Love, 2016). Most of these five measures are already being completed within SBHCs. However, we are not doing an effective job at reporting these measures. Therefore, future recommendations for practice must emphasize the importance of SBHCs reporting their performance measures in order to gain financial support at the state and national levels.

Research

Recommendations for future research should be surrounded on determining the barriers SBHCs are facing regarding reporting these standard performance measures to the National SBHC Quality Initiative. Also, effective use of future research would be to compare the success of those SBHCs who are meeting these quality measures vs. those SBHCs who are not. Future research covering these topics will help ensure sustainability of SBHCs and promote their continued growth.

Summary

SBHCs are a growing healthcare service that does increase access to care. This is especially true for those patients who are underserved, minority, or living in rural communities. SBHCs have a new perspective on healthcare delivery which involves bringing the provider to the patient. Improvement in access to care, decrease emergency department use, and improvement in student and teacher attendance rates are all benefits of this SBHC. However, the lack of financial support and enacted policies at the state level is hindering the wide-spread growth of SBHCs across the nation. Increasing government support through the establishment of

policies regarding SBHCs will help increase financial gain. One way SBHCs can help do this is by participating in the SBHC National Quality Initiative. Once the barrier of financial support is overcome, not only will SBHCs be able to be sustained, but their growth will be incredible.

Appendices

Appendix A:

Cover Page



To Allen County-Scottsville School-Based Health Center Patient/Guardian:

Researchers at the University of Kentucky are inviting you to take part in a survey to provide preliminary data on the impact of the Allen County Scottsville, School-Based Health Center (SBHC) by the Medical Center on access to care and attendance rates. The survey is part of the research study, “The Effect of a School-Based Health Center on Access to Care in a Rural Community.”

Although you may not get personal benefit from taking part in this research study, your responses may help us understand more about the benefits of SBHCs on access to care and attendance rates in rural communities for hopes to grow SBHCs throughout surrounding rural areas. Some volunteers experience satisfaction from knowing they have contributed to research that may possibly benefit others in the future.

The survey will take about five minutes to complete.

There are no known risks to participating in this study.

Your response to the survey will be kept confidential to the extent allowed by law. When we write about the study you will not be identified. Your information collected for this study will NOT be used or shared for future research studies, even if we remove the identifiable information like your name, clinical record number, or date of birth.

We hope to receive completed questionnaires from about 150 people, so your answers are important to us. Of course, you have a choice about whether or not to complete the survey, but if you do participate, you are free to skip any questions or discontinue at any time.

If you have questions about the study, please feel free to contact myself, my contact information is given below, or advisor Judith Daniels at jadani0@email.uky.edu. If you have complaints, suggestions, or questions about your rights as a research volunteer, contact the staff in the University of Kentucky Office of Research Integrity at 859-257-9428 or toll-free at 1-866-400-9428.

Thank you in advance for your assistance with this important project. To ensure your responses/opinions will be included, please return your completed survey via mail by October 31st, 2018.

Sincerely,
Macey Cornwell
College of Nursing University of Kentucky
PHONE: 615-879-0128
E-MAIL: macey.cornwell@uky.edu

Appendix B:*Survey***The Effect of a School-Based Health Center on Access to Care in a Rural Community**

To be completed in regards to the patient seen at the ACS School-Based Health Center and whose name appears on the front of the envelope. Please only complete **ONE** survey per patient and do not include any names or personal identification outside of answering the questions below as this survey will remain anonymous. Thank you for your time and participation!

1. What is the patient's gender?
 - a. Male
 - b. Female
 - c. Prefer to Not Answer

2. What is the age of the patient?
 - a. _____

3. What is the patient's race?
 - a. African American
 - b. American Indian
 - c. Asian
 - d. Hispanic
 - e. White
 - f. Other
 - g. Prefer to Not Answer

4. What is the grade level/employment status of the patient?
 - a. Kindergarten – 3rd
 - b. 4th – 6th
 - c. 7th – 8th
 - d. 9th – 12th
 - e. Full-Time ACS School System Employee
 - f. Part-Time ACS School System Employee
 - g. Not an ACS student or employee

5. How many times has the patient received care at the ACS School-Based Health Center since it opened in January, 2018?
 - a. 0-4
 - b. 5-9
 - c. 10-14
 - d. 15 or More

6. What is the primary reason for most of the patient's clinic visits:
 - a. Acute/Sick Visit (ie: colds, sore throat, new onset illness, etc.)
 - b. Well Visit (annual healthy check-ups, immunizations, etc.)
 - c. Chronic Condition Visit (Diabetes Mellitus, Hypertension, Asthma, etc.)
 - d. All of the Above

7. What type of insurance does the patient currently have?
 - a. Medicare
 - b. Medicaid
 - c. Dual Medicare/Medicaid
 - d. CHIP (Children's Health Insurance Program)
 - e. Private Insurance
 - f. No Coverage
 - g. Other

8. Does the patient currently have an established family provider or routine health care provider?
 - a. Yes
 - b. No

9. Where does the patient go most often when they need to see a provider about a non-emergency health problems or illness?
 - a. Established Family Provider
 - b. ACS School-Based Health Center
 - c. Emergency Room
 - d. Urgent Care
 - e. Other

10. **Prior to** the initiation of the ACS School-Based Health Center (January, 2018), how often did the patient utilize the emergency room to receive health care?
 - a. Always
 - b. Often
 - c. Sometimes
 - d. Rarely
 - e. Never

11. **After** the initiation of the ACS School-Based Health Center (January, 2018), how often has the patient utilize the emergency room to receive health care?
 - a. Always
 - b. Often
 - c. Sometimes
 - d. Rarely
 - e. Never

12. The ACS School-Based Health Center location is easily accessible?
 - a. Strongly Agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

13. The ACS School-Based Health Center provides efficient care that allows the patient to return to class/work where in other cases, if the patient had to go elsewhere to receive care, they would be unable to do so.
 - a. Strongly Agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

14. The ACS School-Based Health Center increases access to health care for sick visit needs?
 - a. Strongly Agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

15. The ACS School-Based Health Center increases access to care for new health problems?
 - a. Strongly Agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

16. The ACS School-Based Health Center increases access to care for preventive health care such as general checkups, examinations, and immunizations?
 - a. Strongly Agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

17. The ACS School-Based Health Center increases access to care for referrals to other health professionals when needed?
 - a. Strongly Agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

18. The ACS School-Based Health Center increases access to health care overall? (Access to care is defined by the World Health Organization as care that is physical accessible, financial affordable, and acceptable.)
 - a. Strongly Agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

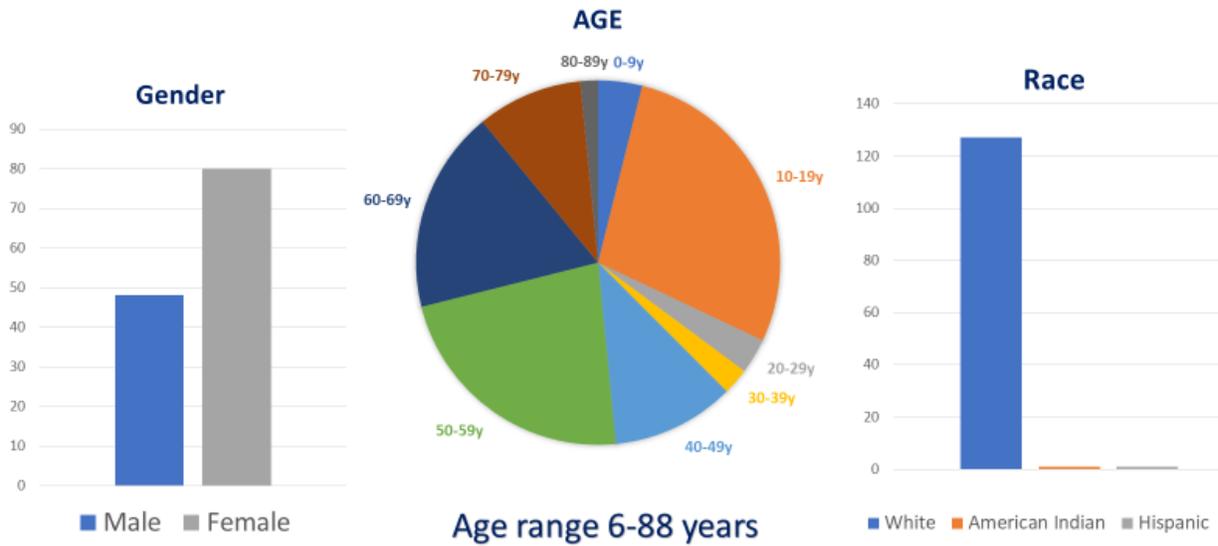
19. The patient would benefit from the ACS School-Based Health Center offering additional resources to improve access to health care? (Such as more providers, locations, hours of operations, and/or specialty services: ie mental health care, dental care)
 - a. Strongly Agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

20. Based on the patients satisfaction from previous visits, they will return for future care.
 - a. Strongly Agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

Appendix C:

Sample Characteristics: Gender, Age, Race

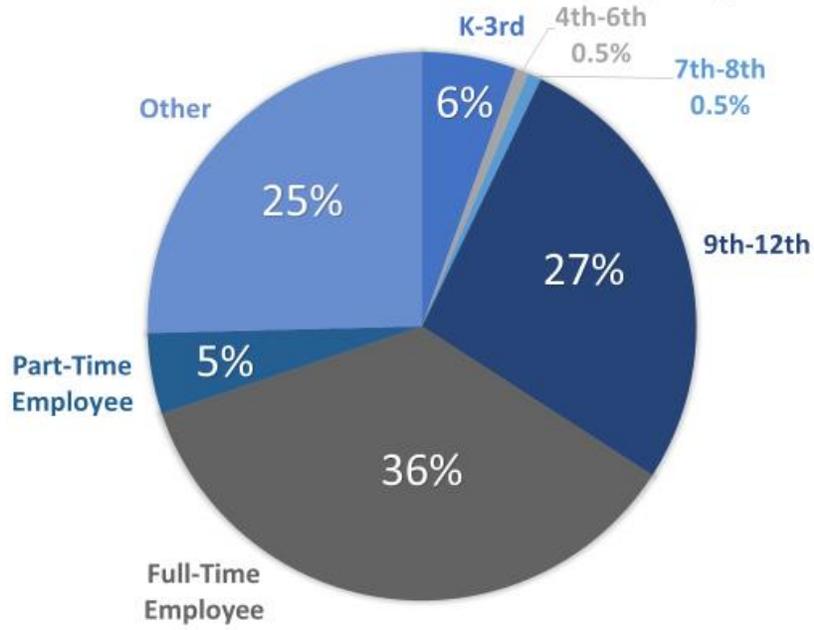
Sample Characteristics



Appendix D:

Sample Characteristics: Grade/Employment Status

Sample Characteristics: Grade/Employment Status



Appendix E:

Number of SBHC Visits

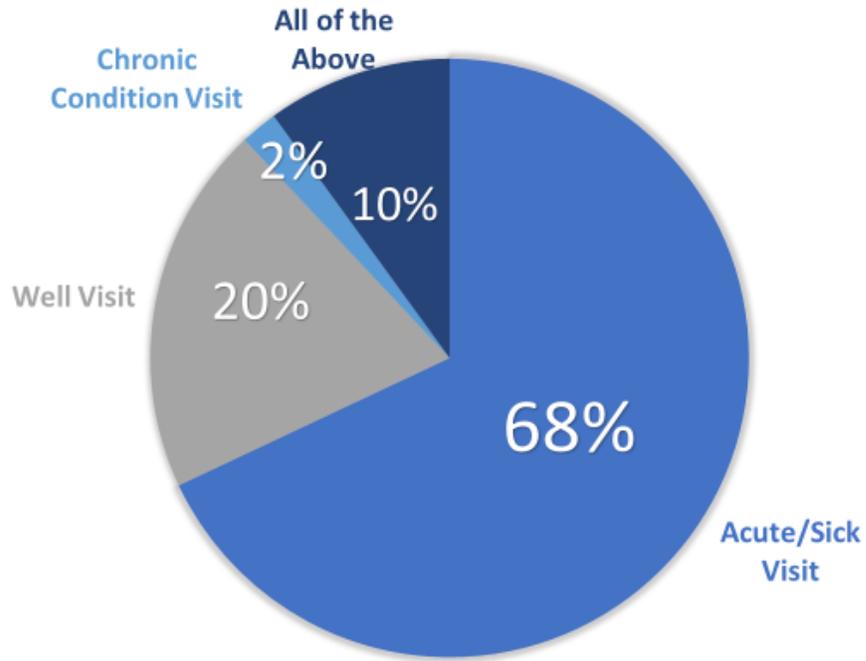
Number of SBHC Visits



Appendix F:

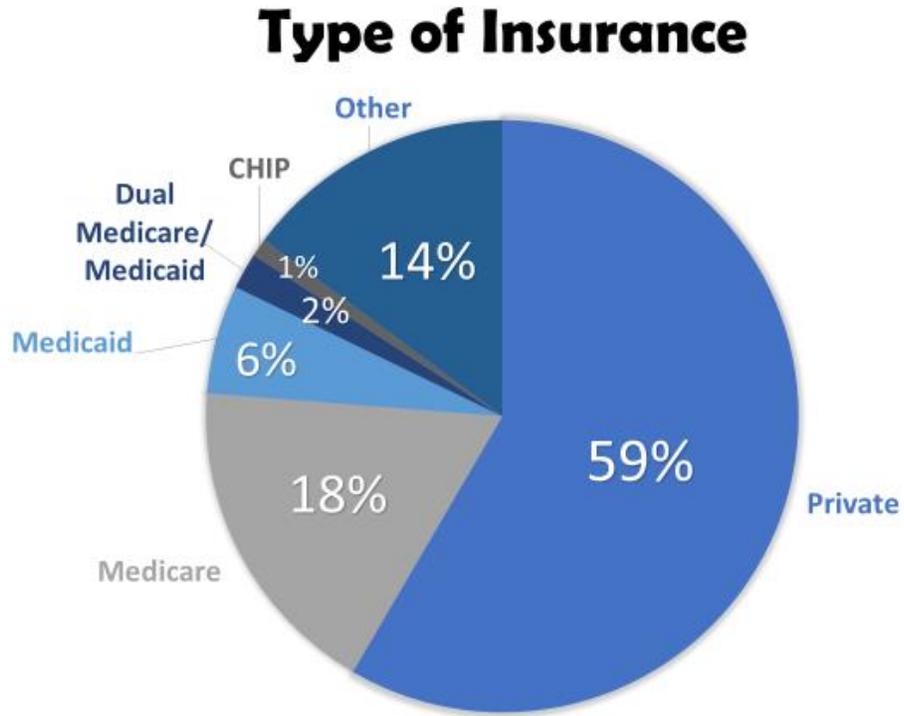
Primary Reason For Visiting SBHC

Primary Reason For Visiting SBHC



Appendix G:

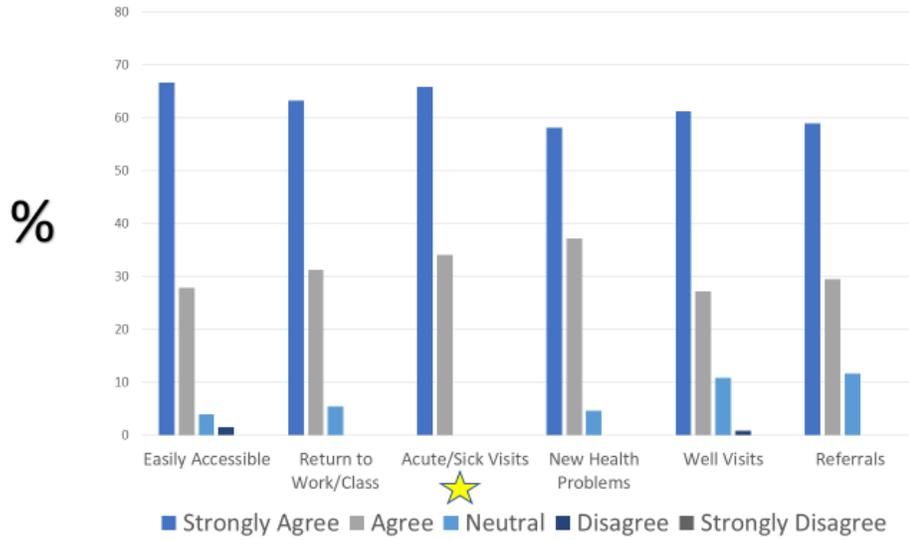
Type of Insurance



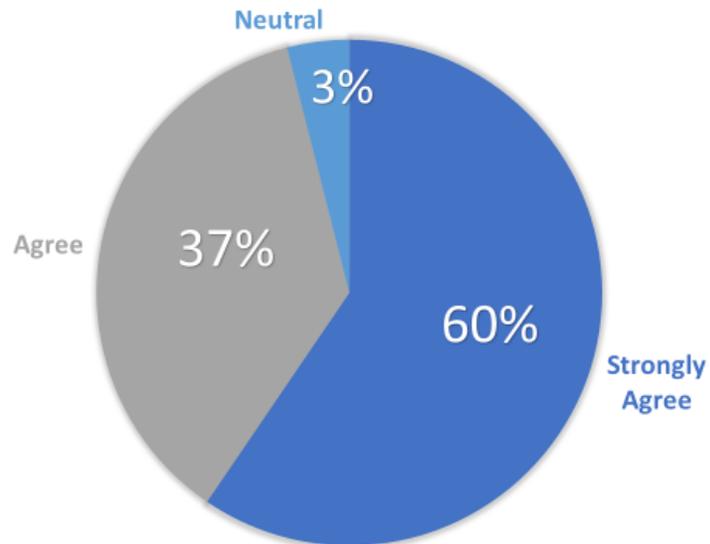
Appendix H:

Perceived Impact of SBHC on Access to Care

Perceived Impact of SBHC on Access to Care



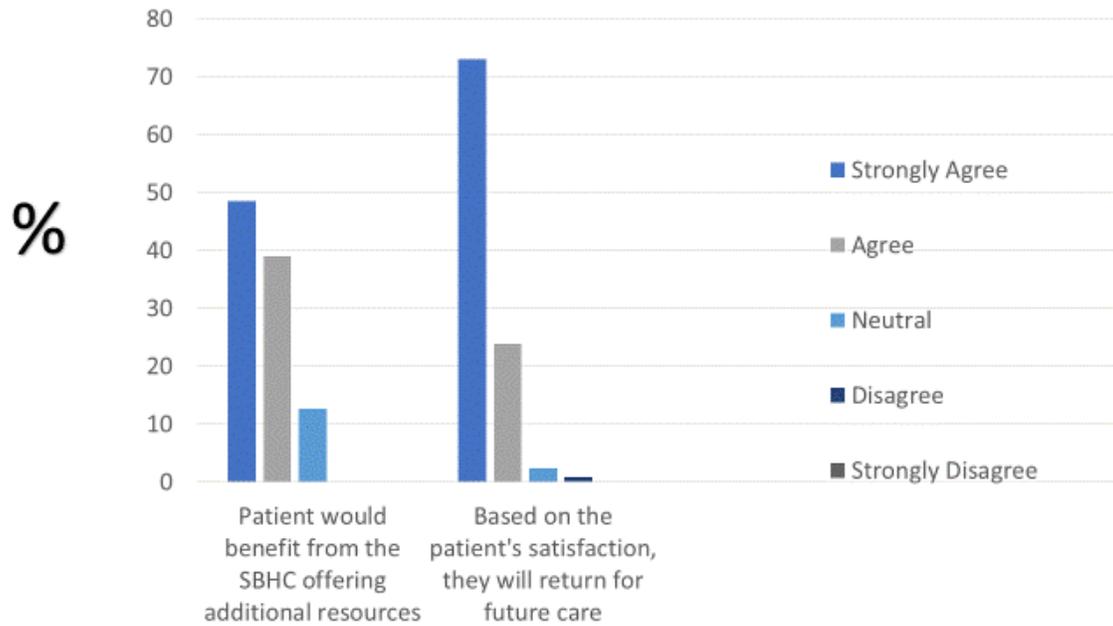
Perceived Impact of SBHC Ability to Increase Access to Healthcare Overall



Appendix I:

Patient Satisfaction

Patient Satisfaction



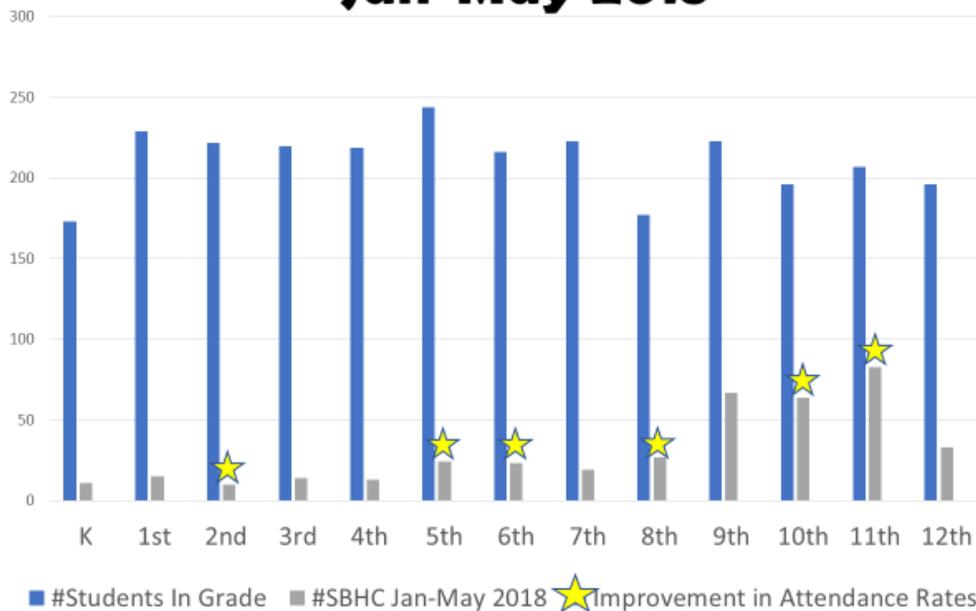
Appendix J:

Student Attendance Rates

Student Attendance Jan-May 2018

Grade	Overall Attendance Rate (%)	SBHC Student Attendance Rate (%)
K	92.09%	91.67%
1 st	93.71%	92.06%
2 nd	93.32%	94.20%
3 rd	94.65%	91.72%
4 th	93.86%	92.12%
5 th	93.82%	94.32%
6 th	93.90%	94.47%
7 th	93.66%	92.63%
8 th	93.61%	94.32%
9 th	93.15%	92.69%
10 th	92.48%	92.98%
11 th	92.11%	92.18%
12 th	90.29%	89.27%

Number of Students Seen at SBHC by Grade Jan-May 2018



Appendix K:

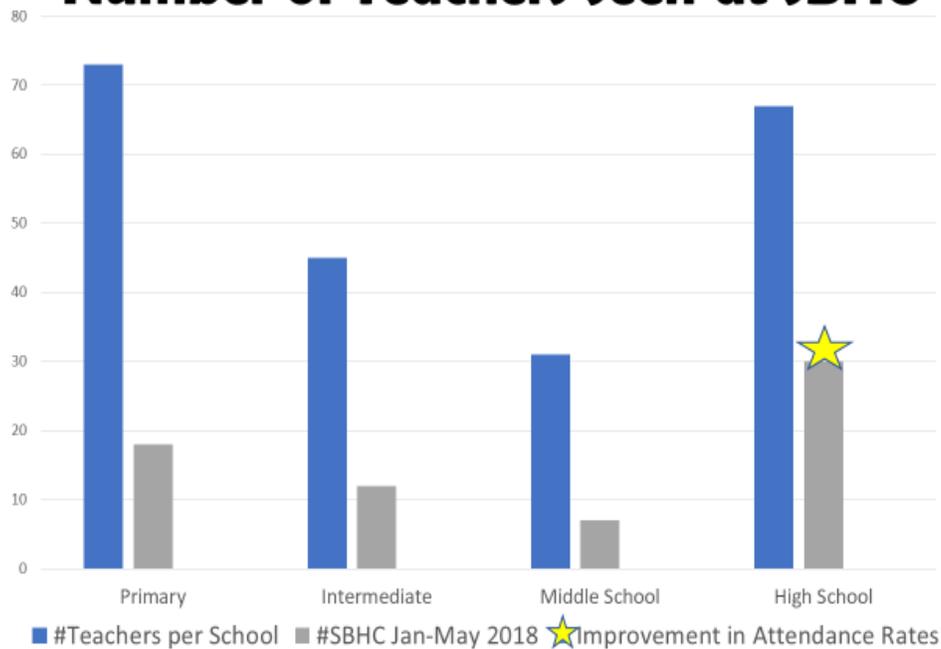
Teacher Attendance Rates

Teacher Attendance Jan-May 2018

Grade	Overall Attendance Rate (%)	SBHC Teacher Attendance Rate (%)
Primary	95%	94.4%
Intermediate	96.3%	94.7%
Middle School	95.2%	94.7%
High School	95.8%	96%



Number of Teachers Seen at SBHC



References

- Albright, K., Barnard, J., O'Leary, S., Federico, S., Saville, A., Lockhart, S., Lee, M., Eblövi, D., Dickinson, M., Kile, D., & Kempe, A. (2016). School-based health centers as medical homes: Parents' and adolescents' perspectives. *Academy of Pediatrics, 16*(4), 381-386. doi: 10.1016/j.acap.2015.06.004.
- Black, L. I., & Schiller, J. S. (2016). *State variation in health care service utilization: United States, 2014*. NCHS data brief, no 245. Hyattsville, MD: National Center for Health Statistics.
- Bloom, B., Jones, L., & Freeman, G. (2013). *Summary health statistics for U.S. children: National Health Interview Survey, 2012*. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.
- Centers for Disease Control and Prevention. (2016). *From 1999-2016, suicide rates rose*. Retrieved from <https://www.wyvt.com/content/news/Interactive-Suicide-rates-increasing-in-US--484987461.html>
- Community Preventive Services Task Force. (2016). School-based health centers to promote health equity: Recommendation of the Community Preventive Services Task Force. *American Journal of Preventive Medicine, 5*(1), 127-128. doi: 10.1016/j.amepre.2016.01.008.
- Evans, D. B., Hsu, J., & Boerma, T. (2013). Universal health coverage and universal access. *Bulletin of the World Health Organization, 91*, 546-646A. doi: <http://dx.doi.org/10.2471/BLT.13.125450>

- Heller, E. (2017). Improving access to care with school-based health centers. *NCSL Legisbrief*, 25(18), 1-2. Retrieved from <http://www.ncsl.org/research/health/improving-access-to-care-with-school-based-health-centers.aspx>
- Knopf, J. A., Finnie, R. K. C., Peng, Y., Hahn, R. A., Truman, B. I., Vernon-Smiley, M., Johnson, V. C., Johnson, R. L., Fielding, J. E., Muntaner, C., Hunt, P. C., Jones, C. P., & Fulilove, M. T. (2016). School-based health centers advance health equity: A community guide systematic review. *American Journal of Preventive Medicine*, 51(1), 114-126. doi: 10.1016/j.amepre.2016.01.009
- Kominski, G. F., Nonzee, N. J., & Sorensen, A. (2017). The Affordable Care Act's impacts on access to insurance and health care for low-income populations. *Annual Review of Public Health*, 38, 489-505. doi: 10.1146/annurev-publhealth-031816-044555.
- Lai, K., Guo, S., Ijadi-Maghsoodi, R., Puffer, M., & Kataoka, S. H. (2016). Bringing wellness to schools: Opportunities for and challenges to mental health integration school-based health centers. *Psychiatric Services*, 67(12), 1328-1333. doi: 10.1176/appi.ps.201500401.
- Larson, S., Chapman, S., Spetz, J., & Brindis, C. D. (2017). Chronic childhood trauma, mental health, academic achievement and school-based health center mental health services. *Journal of School Health*, 87(9), 675-686. doi: 10.1111/josh.12541.
- Lee, J. B., DeFrank, G., Gaipa, J., & Arden, M. (2017). Applying a global perspective to school-based health centers in New York city. *Annals of Global Health*, 83(5-6), 803-807. doi: 10.1016/j.aogh.2017.10.020.
- Love, H. (2016). *November 2016: Quality counts: State and local perspective on adopting and reporting the five performance measures for SBHC*. Retrieved from https://www.sbh4all.org/current_initiatives/nqi/quality-counts-webinars/

- Lukkarinen, A., Koivukangas, P., & Seppala, T. (2016). Relationship between class attendance and student performance. *Social and Behavioral Sciences*, 228, 341-347. doi: <https://doi.org/10.1016/j.sbspro.2016.07.051>
- Mercer, M. (2013). *Howe to beat the doctor shortage*. Retrieved from <https://www.aarp.org/health/medicare-insurance/info-03-2013/how-to-beat-doctor-shortage.html>
- National Assembly on School-Based Health Care (2002). *School-based health centers: A national definition. Position statement of the national assembly on school based health care*. Retrieved from https://www.naccho.org/programs/public-health-infrastructure/performance-improvement/community-health-assessment/maphttp://ww2.nasbhc.org/RoadMap/PUBLIC/Advocacy_SBHCdefinition.pdf
- O'Leary, S. T., Lee, M., Federico, S., Barnard, J., Lockhart, S., Albright, K., Shmueli, D., Allison, M. a., & Kempe, A. (2014). School-based health centers as patient-centered medical homes. *Pediatrics*, 134(5), 957-964. doi: 10.1542/peds.2014-0296.
- Parasuraman, S. R., & Shi, L. (2015). Differences in access to care among students using school-based health centers. *The Journal of School Nursing*, 31(4), 291-299. doi: 10.1177/1059840514556180.
- Paschall, M. J., & Bersamin, M. (2018). School-based health centers, depression, and suicide risk among adolescents. *American Journal of Preventive Medicine*, 54(1), 44-50. doi: 10.1016/j.amepre.2017.08.022.
- Porter, P. J., Avery, E. H., & Fellows, J. A. (1974). A model for the reorganization of child health services within an urban community. *American Journal of Public Health*, 64(6),

- 618-619. Retrieved from
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1775494/?page=1>
- Ran, T., Chattopadhyay, S. K., & Hahn, R. A. (2016). Economic evaluation of school-based health centers: A community guide systematic review. *American Journal of Preventive Medicine*, *51*(1), 129-138. doi: 10.1016/j.amepre.2016.01.017.
- Riley, M., Laurie, A. R., Pleque, M. A., & Richardson, C. R. (2016). The adolescent “expanded medical home”: School-based health centers partner with a primary care clinic to improve population health and mitigate social determinants of health. *Journal of the American Board of Family Medicine*, *29*(3), 339-347. doi: 10.3122/jabfm.2016.03.150303.
- Rogers, V., Salzeider, C., Holzum, L., Milbrandt, T., Zahnd, W., & Puczynski, M. (2016). Keep kids in school: A collaborative community effort to increase compliance with state-mandated health requirements. *Journal of School Health*, *86*(5), 382-385. doi: 10.1111/josh.12389.
- Sallis, J. F., Owen, N., Fisher, E. B. (2008). Ecological models of health behavior. In *Health Behavior and Health Education: Theory, Research, and Practice* (4th ed), ed. K Glanz, B Rimer, K Viswanath, pp. 464-85. San Francisco: Jossey-Bass
- School-Based Health Alliance. (2014). *2013-2014 census of school-based health centers: Methodology, key report data details, and acknowledgements*. Retrieved from <http://www.sbh4all.org/wp-content/uploads/2015/02/2013-14-Census-Data-and-Methods.pdf>
- School-Based Health Alliance. (2018). *Who pays for SBHCs*. Retrieved from <https://www.sbh4all.org/school-health-care/school-based-health-care-financing/>

- Schwartz, K. E., Monie, D., Scribani, M. B., Krupa, N. L., Jenkins, P., Leinhart, A., & Kjolhede, C. L. (2016). Opening school-based health centers in a rural setting: Effects on emergency department use. *Journal of School Health, 86*(4), 242-249. doi: 10.1111/josh.12375.
- U.S. Department of Health and Human Services. (2018). *Access to health services*. Retrieved January 18, 2018 from <https://www.healthypeople.gov/2020/topics-objectives/topic/Access-to-Health-Services>
- U.S. Department of Health & Human Services: National Institutes of Health. (2005). *Theory at a glance: A guide for health promotion practice*. 2nd Ed. Retrieved from [file:///C:/Users/macey/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/NCI%20Theory%20at%20a%20Glance%20\(1\).pdf](file:///C:/Users/macey/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/NCI%20Theory%20at%20a%20Glance%20(1).pdf)
- Uscher-Pines, L., Pines, J., Kellermann, A., Gillen, E., & Mehrotra, A. (2013). Deciding to visit the emergency department for non-urgent conditions: A systematic review of the literature. *The American Journal of Managed Care, 19*(1), 47-59. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4156292/>