# Addressing Mental Health Epidemic Among University Students via Web-based, Self-Screening, and Referral System: A Preliminary Study

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***Abstract*—The prevalence and severity of mental health problems in college and university communities are alarming. However, the majority of students with mental disorders do not seek help from professionals. To help students assess their mental conditions and encourage them to take an active role in seeking care, we developed a web-based self-screening, referral, and secure communication system and evaluated it at the University of Washington for 17 months. The system handled more than 1000 screenings during the study period. Of the subjects who used the system, 75% noted that the system helped them to make a decision to receive help from professionals. The system was able to provide outreach to students with mental health concerns effectively, allow them to self-screen their conditions, and encourage them to receive professional assistance. The system provided students with 24/7 web-based access to the clinic, and more than 50% of the system use was made during off-hours. The system was well received by patients, referral managers, and care providers, and it was transferred to the clinic for daily clinical use. We believe that a web-based system like ours could be used as one way to tackle the growing epidemic of mental health problems among college and university students.**

***Index Terms*—College, Internet, mental health, referral, screening, university, World Wide Web.**

## I. Introduction

THE 2007 incident at Virginia Tech, Blacksburg, in which a student with a serious mental illness killed 32 people and himself and other recent incidents (e.g., one at Northern Illinois University, DeKalb, in 2008) has created a high level of public awareness of mental health conditions among college and university students. As a result, the urgent need to address the mental health problems among students was identified, and some progress has been made, e.g., increasing mental health services, actively informing students of these services, and setting up teams to identify troubled students ahead of time.

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Many college students are in poor mental health, and common mental health issues from which they suffer include depression, anxiety, abuse of alcohol, and other substance use disorders [1]–[5]. The prevalence and severity of mental disorders among the students have been continuously growing [4], [6]. Recent studies found that more than 40% of U.S. students become depressed during their four years in college [7] and that more than 15% have clinically significant depressive disorders [4], [5], [8], [9]. In the last 20 years, the likelihood of a college student suffering depression has more than doubled, and suicidal ideation has tripled [8]. However, the majority of students do not seek professional help for their mental health conditions. Up to 85% of students with positive screens for mental disorders do not receive any treatment from professionals [7], [9]–[12], even though many universities provide counseling free of charge [8]. As a result, there is a significant delay, about 11 years, between the onset of mental disorders and receiving proper treatments [13].

Earlier studies identified factors associated with students not receiving treatment, including lack of problem recognition and perceived need [9], [14], delayed time to an appointment [9], lack of time [9], [10], [15], financial constraints [14], [16], privacy concerns [14], and stigma associated with treatment [10], [15]. Considering the number of students who may benefit from professional help, it is imperative that universities take a more proactive role in offering effective mental health outreach and treatment services to their students [7], [10], [14], [17].

With the widespread availability and adoption of information and communication technology, web-based computerized screening and self-help intervention have been attempted as a more accessible delivery option [18], [19]. Internet-based screening is reported to be reliable and effective in identifying individuals with common mental health problems in college students, including depression [19], [20], anxiety disorders [19], and alcohol dependency [21], [22]. Brief feedback (e.g., screening results and/or recommendations) is effective in managing these problems [18], [23], [24]. Computerized tools could attract potential patients to screen themselves [18], improve recognition of the disorders [25], [26], and motivate them to be more active in receiving appropriate help from professionals [27], [28]. However, screening alone is insufficient for effective management and treatment of mental health conditions. To be more effective, it is desirable that screening be tightly integrated with accessing professional services [9], [29] so that after the mental health need is identified via screening, the students can act on the need in the same session.

To help students assess their mental health conditions and encourage them to seek treatment, we developed a web-based self-help mental health screening, referral management, and communication system. The system was deployed at the University of Washington and evaluated for its utility and usability for 17 months. We sought to determine whether the web-based system is a useful and effective tool for improving mental health services to our students.

## II. Materials and Methods

### A. System Design

The system was designed to have the following four main functions: 1) offer anonymous, web-based, self-screening tools to students;[1] 2) enable students to refer themselves to the mental health center to schedule an appointment; 3) provide a web-based repository to store and share personal health information (PHI); and 4) allow students to communicate with care professionals via secure and asynchronous messaging.

The system consists of three main components: 1) personal health information management system (PHIMS); 2) facilitated accurate referral management system (FARMS); and 3) mental health information management system (MHIMS). PHIMS is a patient-centered, web-based repository of PHI, which allows users to enter, update, or delete structured and categorized information [30], [31]. FARMS is an adjunct personal health application that uses information stored in PHIMS to enable patients to refer themselves to the clinic and to communicate with care professionals through secure messaging [32], [33]. Details of the PHIMS/FARMS system can be found elsewhere [30]–[33]. The PHIMS/FARMS system was built on the Microsoft Windows platform with .NET and MS-SQL (Microsoft, Redmond, WA), while the MHIMS, an anonymous screening component, was built on the Linux platform with PHP and MY-SQL. Data exchange occurs between these components built on different platforms (i.e., PHIMS/FARMS on Windows and MHIMS on Linux) via SOAP-XML-based web services. The screening component was previously developed for a web-based depression screening (PHQ-9) study at the University of Washington (UW) [34]. The screening component offers tools to screen for five common mental health concerns in adults: anxiety (GAD-7, generalized anxiety disorder [35]), depression (CES-D, center for epidemiological studies-depression scale [20]), attention deficit disorder (ADHD, attention deficit/hyperactivity disorder checklist [36]), alcohol use (CAGE, cut down, annoyed, guilty, and eye opener [27]), and eating disorder (EAT-26, eating attitudes testing [37]). To manage user identity (ID) across multiple components running on different operating systems (i.e., PHIMS/FARMS and MHIMS), the UW Net ID, which is a password-protected unique network ID issued to all UW students, faculty, and staff by UW IT services, was used as a single sign-on service. The UW Net ID uses a pubcookie-based authentication mechanism[2] and is needed to use various services offered by UW, including registration, course grade review, and tuition payment. To limit the use of screening to UW students, a valid UW Net ID was needed to access the screening tools. However, the screening component did not record any of identifiable personal information.

The Mental Health Clinic (MHC) system complies with the Health Insurance Portability and Accountability Act (HIPAA) regulations and recommendations by utilizing security measures, such as secure socket layer encryption, encrypted password, audit trail, firewall, integrity control, and automatic logoff, to prevent unauthorized access and dissemination of PHI.

The system was certified by the UW Medicine IT Services as a clinical system in April 2007. The certification process involved review of source code, operating system security settings, and application security configuration. Network-based firewall rule sets and security measures protecting PHI were also thoroughly examined. The certified system was made available to all UW community members in May 2007.

### B. Screening and Referral Workflow

The MHC in the Hall Health Primary Care Center (HHPCC) offers a variety of services to the students, staff, and faculty of the University of Washington. The clinic is the main source for UW students to receive mental health care including free crisis management services. The MHC specifically focuses on treatment of mental health problems that are common among college students, such as stress, anxiety, depression, eating disorders, and grief.

Using the system to self-evaluate mental health conditions and subsequently request an appointment was completely voluntary. The system was intended to provide an alternative way to approach the clinic, not to replace the traditional ways of doing so. Thus, individuals were able to set up an appointment via calls or visits without any penalty for not using the web-based system. Links to the MHC system appear on the UW Medicine HHPCC website.[3]

Fig. 1 shows the workflow with the system. A student can start the mental health self-assessment anonymously by using one or more (up to five) screening tools. Once the screening session is completed, the system gives feedback on his/her condition. If any of the screening scores exceeds the preset threshold, the system encourages the student to start the referral process by providing a link to the referral component. If the student decides to self-refer to the MHC, the system automatically links the current information in the screening component to the referral component (i.e., PHIMS/FAMRS), and he/she is redirected to the referral component so that an appointment can be requested online. The linked information includes the details of his/her screening test(s), e.g., test starting time, test completion time, his/her answers to the test questions, and screening scores and results (i.e., positive or negative). A student also has an option to initiate a referral without completing any screening session.

To schedule an appointment in the referral component, the student must disclose his/her identity, and he/she is asked to

[1] Although the system is available to faculty and staff as well, most users have been students. Thus, we use the term "students" as users and/or potential users of the system in this paper.

[2] http://www.pubcookie.org/.

[3] http://hallhealth.washington.edu/mentalhealth.

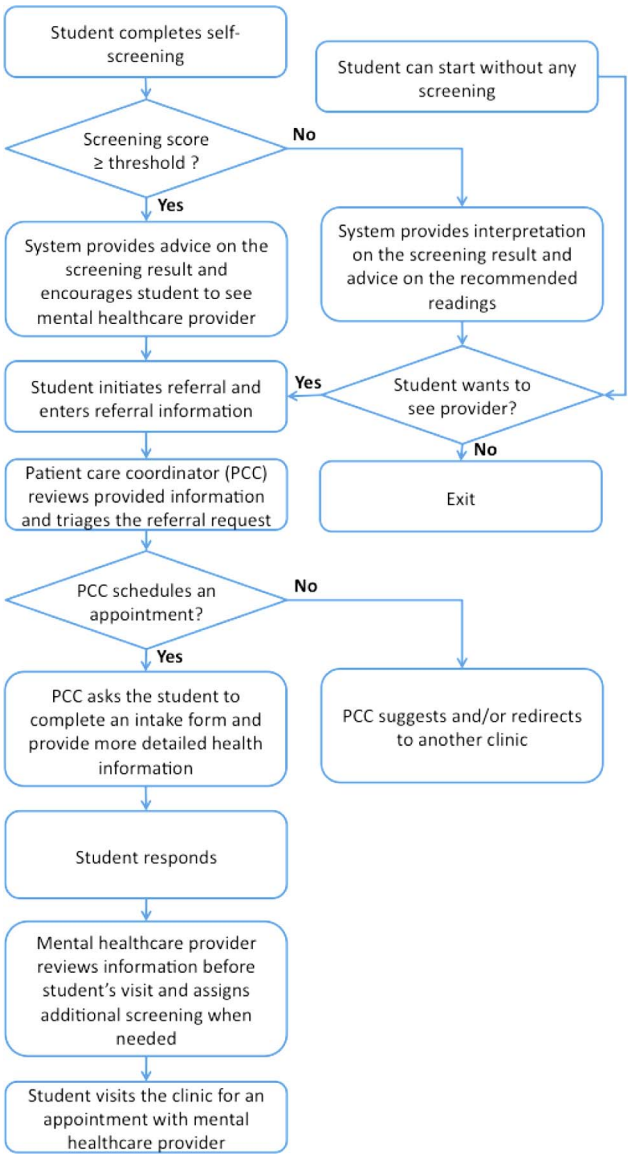


Fig. 1. Workflow with the system.

provide additional information, such as contact information, medications, family history, and intake forms. Once completed, the request is forwarded to patient care coordinators (PCCs) for processing. A PCC can exchange messages with the student via secure messaging to request additional information or provide information about the referral status. For effective triage, the system informs the PCC whether a student is screened positive or not on a specific test, but does not provide any detail. Once an appointment is scheduled with a care provider, the provider can access the information and exchange messages with the student and if necessary ask him/her to complete an additional screening test(s).

### C. Data Collection

System usage and user feedback data were collected in accordance with procedures authorized by the Institutional Review Board at the UW. An online survey using a 7-point Likert scale was administered to evaluate the system usefulness, overall student experience with the online screening and referral process, and its impact on treatment that the student received for mental health concerns. The survey questionnaire was compiled from a variety of existing instruments, including the technology acceptance model (i.e., perceived ease of use and perceived usefulness) [38], [39], IsoMetrics (web usability) [40], and typical metrics used for measuring perception of usefulness and satisfaction in telemedicine [41]. After the appointment date at the MHC, the survey was made available to those students whose appointment had been scheduled by the system. At the conclusion of the study, feedback about system usefulness was collected from the staff and clinicians as well.

User activities, such as information updates and retrievals, were measured from the server/database logs and the audit trail feature in the system. The logs and audit trail recorded the details of user activities, type of activities (e.g., enter, update, or delete), and the date, time, and duration of each access.

### D. Data Analysis

The questionnaire responses and system logs were processed using MATLAB with Statistics Toolbox (The Mathworks, Inc., Natick, MA) and SPSS (SPSS, Inc., Chicago, IL). Exploratory descriptive statistics were used to examine the questionnaire responses and the frequencies and patterns of user activities.

## III. Results

For 17 months (from May 2007 to September 2008), the system logged more than 2700 visits for self-screening and handled 1003 screening sessions. The number of students who used the referral component of the system was 527 with 416 (78.9%) coming after self-screening. Among 527 students using the referral component, 423 students (80.3%) submitted 438 referral requests. Among those who requested a referral, 67.4% (285/423) got an appointment at the MHC, while 32.6% (138/423) did not get an appointment. The remaining 104 students came to the referral section but left the system without requesting a referral. Approximately 30% of the 138 students who did not get an appointment were referred to other specialty clinics, because either the HHPCC did not cover the specialty that the student had requested, such as substance use, or the student could receive better insurance coverage elsewhere. The remaining 70% of the 138 students did not respond to the PCC's requests on providing more health information or confirming the appointment date and time. All 285 students who were scheduled for a clinic visit were asked to participate in the user survey and 57 (20%) completed the survey.

### A. Patient Age and Gender

The age of students who completed the referral request and provided demographic information ($n = 423$) ranged from 17 to 47 years with a mean of 25.5 years (standard deviation: 5.7). Males accounted for 32% and females for 68%.

TABLE I
USE OF SCREENING

| Screening Test | Number of Tests [a] |
|---|---|
| CES-D (depression) | 667 |
| GAD-7 (anxiety) | 533 |
| ADHD (attention deficit/hyperactivity disorder) | 207 |
| EAT-26 (eating disorder) | 158 |
| CAGE (alcohol use) | 94 |
| Total | 1659[b] |

[a]1,003 screening sessions.
[b]1448 (87.3%) tests were positive.

### B. System Usage

Students recorded 1003 screening sessions that had at least one completed test. Among the five screening tests made available, the depressions screening (CES-D) was used most frequently, and the general anxiety screening (GAD-7) was the second most frequently used (see Table I). Each screening session had an average of 1.7 screening tests, and the majority (58%) had a single screening test. From 1003 screening sessions, 82.7% (829/1003) had at least one positive screening result where further professional evaluation was warranted. Approximately one half (503/1003) of the screening sessions were done by 416 students (1.2 screening sessions per student) who subsequently proceeded to the referral process after their respective screening sessions. From these 416 students, 323 (77.6%) requested 333 referrals. Among these 323 students, 304 (94.1%) had at least one positive screening result. The remaining 105 referral requests were initiated by 100 students who did not complete any screening test and came directly to the referral component.

The system use by students was assessed based on page hits. The usage peaked between 6:00 P.M. and 7:00 P.M. (29.4%, 14779/50309), but the system was heavily used between noon and 1:00 P.M. (16.6%, 8326/50309) as well. About 6.1% (3058/50309) of the system use happened over the weekend. Just over half (51.8% or 26076/50309) of the system use occurred when the clinic was closed (between 5:00 P.M. and 8:00 A.M. next day and weekends).

### C. Survey Response

The survey responses from 57 students are summarized in Table II. Over 95% of the survey respondents did not face any difficulties in understanding the instructions on the website and entering information, but around 10% said the system was not easy to navigate. 75% (43/57) found the screening contributed to making their decision to see a counselor, and only 4% (2/57) disagreed. More than 80% were satisfied with the overall online screening and referral experience, and 90% noted they would use a similar system again for other referrals or appointments, if available.

TABLE II
SUMMARY OF STUDENT SURVEY RESPONSES

| Responses |
|---|
| • 56/57 (98.2%; 95% CI = 89.8, 100) indicated that the system was easy to use. |
| • 43/57 (75.4%; 95% CI = 62.8, 84.9) denoted that the screening tool was helpful to make his/her decision to see mental health care professionals. |
| • 50/56 (89.3%; 95% CI = 78.2, 95.4) felt comfortable communicating with the referral managers and/or care providers using the website. |
| • 53/57 (93.0%; 95% CI = 82.8, 97.7) indicated that the amount of time it took to receive a response from referral managers and/or care providers was acceptable. |
| • 31/55 (56.4%; 95% CI = 43.3, 68.6) felt his/her face-to-face meeting time with care providers was used more efficiently after filling in my information in the website |
| • 29/57 (50.9%; 95% CI = 38.3, 63.4) thought that the system improved the quality of overall healthcare he/she received (22/57, 38.6% neutral). |
| • 45/56 (80.4%; 95% CI = 68.0, 88.8) were overall satisfied with the PHIMS system. |
| • 50/56 (89.3%; 95% CI = 78.2, 95.4) stated he/she would use similar online referral systems for other referrals/appointments, if available. |

• 95% confidence intervals are calculated based on the adjusted Wald method.

## IV. DISCUSSION

This study demonstrates the usefulness of a web-based, integrated self-screening, referral, and history gathering system for mental health in a university community. Conventional screening systems offer anonymous self-screening, feedback on the screening results and relevant referral information (e.g., contact information of mental health clinics). Our integrated system adds a streamlined referral mechanism, where a student can schedule an appointment online. Our system also made the student-provided information available to mental health care providers in advance of the visit.

### A. Principal Findings

During the study period, the system completed more than 1000 self-screening sessions with at least one completed test, and more than one half (503/1003) of the screening sessions resulted in a student's proceeding to the referral section of the system. Near the end of the study period, the system handled up to 77 screening sessions per day and received up to 55 referral requests per month. During the first 12 months of system use, the MHC experienced a 13% increase in student patient volume. Given the growing prevalence and awareness of mental health problems in university communities [4], [6], [8], the availability of this system alone may not fully account for this increase. However, considering the past history in volume changes at the clinic (around 3–4% increase per year prior to

the system deployment) and the fact that many referrals have been made online with the system, we believe that the system contributed significantly to the volume increase. The active system use with increased patient volume suggests that the web-based screening and referral system was effective for students in seeking and receiving professional help. The system was particularly useful in: 1) helping students in identifying their mental health problems and acting on the identified problems and 2) providing web-based access to the clinic for screening and scheduling.

The impact of the screening tests and streamlined referral process on students' behavior of seeking help was indicated by those who requested an appointment after learning positive screening results. Of the 829 positive screening test results, 42.1% (349) led to subsequent referral requests, while 18.4% (32/174) with the negative screening results did so (odds ratio: 3.23, 95% CI: 2.15–4.85, $p < 0.001$); a student with positive screening results was more likely to request a subsequent referral after screening than one with negative results. This finding is congruent with a previous alcohol use screening study with general population, where subjects with positive screening sought additional information for treatment options than those with negative screening [18]. In addition, the survey responses also agreed with the role of the screening tests as 75% (43/57) reported that the screening tests contributed to their decision to see mental health professionals. As the lack of perceived need and problem recognition is known to a significant barrier to receiving timely treatment for mental illness in university communities [9], [14], offering a web-based screening system could be effective in helping students identify their problems.

The 24/7 availability of the web-based integrated system allowed students to not only assess their mental health conditions but also request self-referrals more easily and conveniently. As reported in earlier studies, up to 55% of the students in need of mental health services reported lack of time as a barrier to seeking and receiving professional services [9], [10]. During the study period, more than half (51.8%) of the system use occurred while the clinic was closed. While the students actively used the system between noon and 1:00 P.M. (16.6%), the level of activities was maximum between 6:00 P.M. and 7:00 P.M., accounting almost 30% of the total system use. Also, more than one half of the screening sessions were done during the clinic off-hours. This heavy off-hour system use confirms the time constraints that students face in scheduling an appointment and receiving appropriate care and suggests that the system helped lower this barrier.

The system was well received by students, care providers, and PCCs. Providers and PCCs noted the system worked well as they found that it was easier to reach students via the system than phone calls. Providers stated that the availability of screening results and patient-provided information prior to the clinic visit enabled them to be better prepared for the counseling sessions, which is congruent with previous findings [32]. PCCs also commented that easier access to the clinic enabled by the system encouraged more students to seek help from professionals. Consequently, the ownership and management of the system was transferred from researchers to the clinic to be fully incorporated into their routine clinical practice in October 2008. The system has been in active use on a daily basis since then.

### B. Implications

Earlier studies reported that the prevalence of mental illness among college students ranges from 13% to 18% [2]–[6], [9], [11] and up to 85% of students who would screen positive for mental health problems do not receive any treatment [7], [9]–[12]. If these numbers were applied to approximately 40000 students at the UW Seattle campus, there would be 6000 students who are in need of mental health care. However, only around 900 (15% of the 6000 students) would seek and receive treatment, and the remaining 5100 students would not do so. During the final 12 months of the study period (from October 2007 to September 2008), our system handled 841 completed screening sessions from 701 students and 95 appointment requests without any screening session. Thus, the system allowed around 800 students to assess their mental health conditions and/or request appointments. Some of these 800 students were likely to belong to the majority group of 5100 students who would be screened positive for mental illness but not receive any treatment. This suggests that the system has demonstrated its usefulness in outreaching to students in need. With additional screening tools (e.g., bipolar disorder and post traumatic stress disorder) and increased publicity and usefulness in the future, the system would enable more students to take more active approach to their mental conditions and getting professional help.

### C. Limitations

A limitation in the survey sampling needs to be noted. Only the students who were scheduled for a clinic visit were invited to participate in the survey. Therefore, the survey responses might have been biased toward the positive side, since the students who did not have their appointment scheduled tend to express more negative opinions [32].

## V. Conclusion

We created and evaluated a web-based, integrated, self-help mental health screening, and referral system for students in a university community. We demonstrated the system's effectiveness with the followings: 1) an increase in student patient volume; 2) high off-hour system use (more than half of system use occurred during the clinic off-hours); 3) the number of students used the system (>900 for the last 12 months of the evaluation period); and 4) the positive survey responses from students. The results suggest that the system helped students recognize their mental health problems and encouraged them to seek and receive professional care. The system was well received by students, care providers, and patient care coordinators. Subsequently, it was converted from trial deployment to routine clinical use in the clinic. As mental health issues in college/universities community continue to grow, offering screening and referral systems like ours would benefit our students in taking more active role in managing their mental health concerns.

## APPENDIX

### SURVEY QUESTIONNAIRES FOR THE MHC STUDENTS

1) I understood the instructions and messages displayed on the screen easily.
2) The website was easy to navigate (e.g., move back and forth between different screens).
3) Filling in my PHI was easy.
4) The screening/assessment tool was helpful to make my decision to see counselors.
5) Using the website, I felt more in control of coordinating my health care.
6) I felt comfortable communicating with the referral managers and/or counselors using the website.
7) The amount of time it took to receive a response to my requests/questions was acceptable.
8) I would have preferred to schedule an appointment by telephone rather than with the online referrals website.
9) The website allowed me to provide more health information than would otherwise be possible.
10) My face-to-face meeting time with my counselor/specialist was used more efficiently after filling in my information in the website.
11) I think the website has improved the quality of overall healthcare I receive.
12) In general, I was satisfied with the entire online referral process.
13) I would like to use similar online referral systems for my other referrals/appointments, if available.
14) Please use the remaining space to write any comments regarding your experience using the referral system and any suggestions for improvement.

*Scale:* strongly agree (7); agree (6); somewhat agree (5); neutral (4); somewhat disagree (3); disagree (2), and strongly disagree (1).

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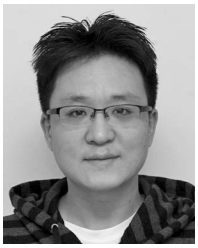

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