# Health Dome: Towards Preservation and Promotion of Holistic Health of College Students

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College-going years are filled with several life-persisting and changing developments in various dimensions including socio, economic, psychic, and health. Colleges are very careful in who they admit to their various disciplines. The admission criterion for most of the prestigious colleges although not openly disclosed is mainly focused on academic and other achievements which potentially indicated good chances of academic success as well as citizenship. During the college studies the academic performance on the subject matter is primary criterion for assigning grades. The employers hire based on behavioral and technical interviews. Given the depressed job market for many areas in the recent years, once hired a new employee is expected to spend exorbitant amount of time doing work related tasks. Hence from the time a kid decides to go to college there are lot of stresses such as stress to perform well in standardized tests, stress regarding how to pay for college, etc which have impact on student's health in several ways including changing healthy habits and adoption of many unhealthy behaviors to relive stresses including addictions to drugs, alcohol, and gaming. Although the problem is clear, it is not clear what can be done about it. The problem seems to be akin to concussion problem in football – the negative health impact seems to be so ingrained that they seem to be part and parcel of the college-culture. Nothing less than complete overhaul of the college-system would seem to address the real issue. However, even this won't be enough since the real problem may be outside the college: in home (with parent, sibling), in society (with friends, girl/boy-friend, spouse), and at work (with employer, colleague). Although Universities take into account socio-economic hardships in admission decisions, expecting them to take into account health-related criterion has potential to cause more chaos than provide remedy to the health crisis of college students.

Even if we can eliminate the above mentioned stresses for the sake of preserving and promoting student health, one should ask the question what impact this would have besides the health consequences. All stresses are not bad. Stress in itself is a very good motivator for students to work harder and do things differently to relive the stress. What seems to be problem are behaviors such as procrastination, wrong estimation of one's ability, poor time management, in-ability to say no, etc. which contribute to creating situations leading to stress. Some of these are ingrained in the personality of a person. However, many of these behaviors can be modified with conscious efforts by anyone not just college going students. Also some universities have freshman courses (e.g. 1 credit hour ASU 101) which familiarize the incoming student with the University resources and disciplinary expectations and resources available to assist them if and when they need them.

In recent years, there has been advances in physiological and other sensing technology which combined with analytical techniques can provide real-time health advice to a person. The question is can these technologies be adapted or further developed to help promote and preserve college student health in effective manner. One can imagine a future wherein *on first day of college students pass through a corridor and their physical, physiological, mental and social vitals are collected in an instant. In the first class of the day, they learn that a part of their grade depends on their success in maintaining or improving their health stats during the semester. Colorful tiny drone hovers around the campus remotely scanning students' eyes, brain, and gait information. In the canteen, food plate equipped with a calorie counter tells how much one is gaining with each bite of your sandwich. In dorm room a student's look-alike virtual avatar, albeit aged 20 years in the future with a projected health based on student's current status provides health advice to student. Social interactions are monitored to grade you on the hotness chart. The dorm bed monitors student's sleep and stress levels and adjusts the alarm clocks according to student's schedule and recommended sleep duration.* Such a college **Health Dome** potentially highlights

a) Disruptive incorporation, where student health is incorporated in important functions in the college. For example, health state may have contributions to the grade, improvement in health amounts to discounts in health insurance, and scheduling classes far apart so that students are forced to walk. b) Instant health stat support, which pervasively and non-invasively monitors a student's vitals including vitals from his/her blood. Inconspicuous drones can fly around the campus capturing a full image of a student's body. Image processing can then be used to determine vitals which are otherwise invasive to measure. For more sophisticated measurements, health corridors maybe installed such that one pass through the corridor will result in vital scans such as MRI. c) Augmented health, where the health stat data for each student will be used to provide motivational feedback through personalized virtual avatars. Such avatars may also be used to engage the student in healthy social interactions, and help attain desired mental states.

**Technological challenges**: HealthDome will require solutions to several technological grand challenges of which we discuss a few:
a) *Proximity Non-invasive Sensing*: In HealthDome, the idea is to sense non-invasively without any interruption to the student's day to day life. Hence, sensing has to be performed without installation of any wearables or implantables. Further, vitals such as lipid profile, blood glucose levels have to be obtained without affecting the student. b) *Compressed computation*: Transfer, storage and analysis of big data, continuously streamed from students will require data compression schemes that are much more efficient than currently available. The state-of-the-art compressive sensing techniques take full advantage of data sparsity in linear transform domain. However, physiological signals such as cardiac or brain signals may have sparsity in a non-linear transform domain. Computation in Health Dome may not only require compressed sensing but may also benefit from analytics algorithms that operate on compressed data instead of the recovered raw data. This may help achieve real time operation in HealthDome. c) *Automated mental health assessment*: Automation in mental health assessment is challenging due to the high sampling rate, absence of accurate remote sensing methods, and chaotic nature of brain signals. Interventions for mental health are mostly reactionary since brain signal prediction is extremely inaccurate. We need a paradigm shift in brain research where generative models representing the operation of an individual's brain can be built and used for diagnosis and interventions. With such a model, the consequences of a student's social interactions on his/her mental health can then be predicted and immediate interventions can be deployed such a prevention of bullying, or employment of a different grading scheme.
**Prior Experience of Author:** The author is chair of Computer Science at ASU and deals with lot of issues of college students. Author's research experience primarily covers novel proximity based physiological sensing, mobile computing, privacy, health data processing, and design of safe cyber-physical medical control systems. The author has an ongoing SCH project that focusses on development of safety assured medical devices such as artificial blood glucose control systems. The PI also has an ongoing NIH funded project where a large scale clinical study is being conducted to test the efficacy of a novel energy efficient cardiac sensing mechanism. The notable outcomes of the PI's research in sensing domain include non-contact ECG sensing techniques, and generative models based energy efficient sensing. The PI has also focused on mobile app based intervention to induce healthy behavior in college students. He has developed the bHealthy mobile app that monitors a student's physical activity and mental states through wearables and provides motivational feedback through the usage of virtual pets or avatars. Another notable contribution is the HealthDev automated mobile app development framework that enables model based design, verification, and implementation of mobile medical applications. The author has also initiated the BraiNet project, which focusses on predictive modeling of human brain for real time augmented reality applications.