Executive Summary: Team 8
Cervical Cancer Screening Simulator

Jeff Chu
Jeff Hong
Julia Kramer
Maria Young

December 12, 2013

The developing world holds the burden of cervical cancer fatality, due primarily to a lack of infrastructure for traditional cervical cancer screening techniques. The Pap smear, the "gold standard" for cervical cancer screening in high-resource settings, is often inaccessible or non-existent in low-resource settings as it requires a cytology lab to interpret its findings. Visual inspection of the cervix with acetic acid (VIA) is a low-cost and effective method to screen for cervical cancer for women in resource-limited settings due to its simple nature and single-clinical-visit style of determining results. Despite the benefits of the VIA method, it is not currently widely used due in large part to a lack of training and awareness of the method.[3,1] Therefore, a need was identified for a simulation device to assist in training healthcare providers in resource-limited settings to accurately screen for cervical cancer using visual inspection with acetic acid.

Information to define user requirements was pulled from a variety of sources including the experiences of two team members who participated in an eight week clinical immersion experience in Ghana, interviews with healthcare professionals, and literature reviews. User requirements were then ranked and quantified into engineering specifications as shown in Table 1. Multiple sub-concepts were generated to address individual sub-functions of the system as outlined in Figure 4. These sub-concepts were evaluated and eventually combined into an alpha concept which was further iterated into the beta and gamma concepts. Iterations from the alpha concept to the final concept (gamma concept) were guided by discussion with professors, interviews with medical professionals, and feedback from midwifery students.

The final design consists of two components to aid in VIA training. Component (1), as shown in Figure 16, is a viewfinder mechanism with an LCD user interface to record user input and provide feedback. The user views images on the viewfinder by looking through a silicone vaginal cavity, allowing the user to practice passing a speculum, visualize unique cervical situations, and test themselves on the diagnosis of each cervix as VIA positive or VIA negative. Component (2) is a cervical model with color changing material that will display acetowhite lesions upon application of a test solution. This component allows the user to

visualize the color change of the cervix during the VIA procedure and reinforces the notion that application of acetic acid is imperative for accurate inspection and diagnosis. Component (2) development was not included in the scope of this semester.

A prototype of component (1) was constructed in the U of M Mechanical Engineering Machine shop, utilizing laser cutting, lathe, and band saw operations, as well as silicone compression molding. End cost per prototype if excess materials purchased were utilized was $81.93, an overshoot of the target price per prototype by 205%. Evaluation of the prototype showed that 4 of the 9 engineering specifications were validated, 2 were partially validated, and 3 specifications were not met and provide opportunity for future work before implementation.

In review, major shortcomings of the design include the presentation of the cervical images, the over-budget total cost of the price per prototype, as well as the lack of intuitiveness of the device. Future design refinement will continue especially in the areas of image wheel redesign, cost optimization, and an increase of local manufacturability potential in Ghana.