Solutions in Global Women's Health Care Delivery: Use of Mobile Telemedicine for Cervical Cancer Screening

Rachel H. Gormley[a], Kelly E. Quinley[a], Ting Shih[b], Zsofia Szep[c], Ann Steiner[d], Doreen Ramogola-Masire[e], and Carrie L. Kovarik[c,f]

[a] *University of Pennsylvania School of Medicine, Philadelphia, PA*
[b] *Click Diagnostics, Boston, MA*
[c] *Department of Medicine, Division of Infectious Diseases, University of Pennsylvania Medical Center, Philadelphia, PA*
[d] *Department of Obstetrics and Gynecology, University of Pennsylvania Medical Center, Philadelphia, PA*
[e] *Botswana-UPenn Partnership, Women's Health Initiative, Gaborone, Botswana*
[f] *Department of Dermatology, University of Pennsylvania Medical Center, Philadelphia, PA*

Abstract and Objective

Throughout the developing world, delivery of women's health care, specifically cervical cancer screening, is limited by cost and access to trained personnel. Visual inspection with application of 4% acetic acid (VIA) is a practical, inexpensive alternative to cytology-based screening in areas where women's health resources are limited. We present results of a prospective case control study evaluating the accuracy of off-site (remote) expert diagnosis using photographic images of the cervix with VIA (PIA) in HIV-positive women in Gaborone, Botswana. Mobile telemedicine using the 5 Megapixel camera-enabled Samsung Soul U900 cell phone to photograph the cervix after VIA allows clinicians in "see and treat" cervical cancer screening clinics to capture high quality images of the cervix. Photos can then be transmitted via the mobile phone to a gynecology specialist located remotely, in order to provide accurate diagnosis of precursor lesions, and appropriate triaging and implementation of therapy.

Keywords:

Mobile telemedicine, Cell phones, Cervical cancer screening, HPV, HIV/AIDS, Botswana

Methods

ClickDiagnostics has developed software (ClickDoc) specifically for remote diagnosis with the Samsung Soul U900 phone, which comes equipped with a 5 Megapixel camera. In our prospective case control study, 95 women presenting to Bontleng Clinic in Gaborone were enrolled and had: (1) VIA evaluation by an onsite clinician, (2) an HPV sample taken, (3) cervical photos taken with the Samsung Soul U900 phone 5 Megapixel camera, (4) photos evaluated by original onsite clinician and by a remote gynecology specialist blinded to the initial visit. VIA and PIA results were categorized as "positive," "negative," or "indeterminate." Percent agreement including 95% confidence intervals will be calculated for each pair of diagnostic impressions: 1) off-site gynecologist based on PIA to on-site clinician using VIA; 2) on-site clinician using PIA to on-site gynecologist using VIA; 3) off-site gynecologist based on PIA to on-site clinician using PIA. Comparisons of percentages of positive vs. negative will be performed using the McNemar's test. The kappa statistic will be used to measure reproducibility between PIA and VIA. Sensitivity and specificity characteristics along with 95% confidence intervals for the PIA in comparison to VIA will be determined, along with positive and negative predicative values for the PIA.

Results

All 95 subjects were enrolled, 71% were positive for HPV, with a mean number of strains of 2.23 per patient. The most common types detected were HPV 35 (13%), 16 (9%), 33 (9%), 30 (8%), 51 (6%), 52 (8%), 53 (9%), 58 (9%); and HPV 18 in only 2%. Preliminary photo concordance data will be presented, and initially suggests that strong concordance when comparing on-site clinician diagnosis to diagnosis using telemedicine photos.

Conclusions

Women in sub-Saharan Africa often present with advanced cervical cancer, even though precancerous lesions are detectable. This is the result of multiple factors, including lack of screening, lack of appropriate referral, as well as HIV-HPV co-infection. In order to improve the availability of cervical cancer screening in Botswana, we propose the use of mobile telemedicine as an adjunct tool to visual screening techniques for cervical cancer. We aim to show that mobile telemedicine technology is a reliable method for diagnosing cervical lesions compared to in-person gynecological evaluation, and that use of this technology has the potential to connect resource-poor cancer screening centers to remotely-located gynecologists, with scale up providing affordable screening for women throughout rural Africa with otherwise limited access to care.

Corresponding Author:

Carrie L. Kovarik, MD, University of Pennsylvania, Department of Dermatology, 3600 Spruce Street, 2 Maloney Building, Philadelphia, PA 19104, USA
P: +001-215-662-7324/email:Carrie.Kovarik@uphs.upenn.edu